# PATENT ABSTRACTS OF JAPAN

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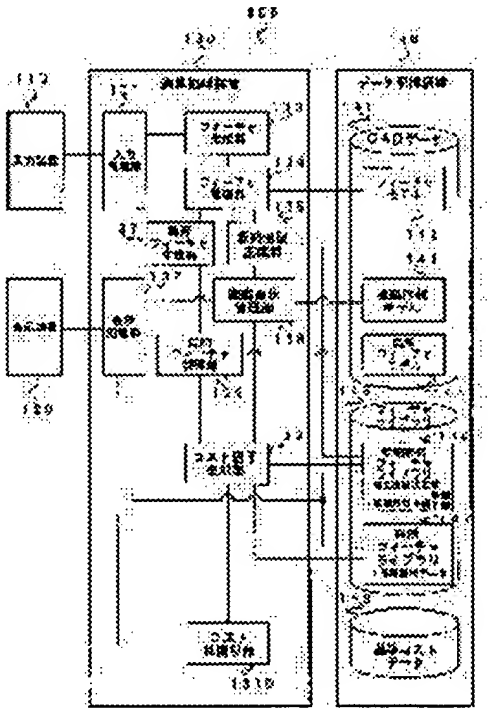
## (54) DESIGNING SUPPORT SYSTEM

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a designing support system which calculates an estimated cost from CAD data on components that a user inputs and shows the cost estimated value of a design object to the user.

SOLUTION: Punching machining information is stored as a local feature in a library 147. A machining method (including nibbling) other than punching is stored as an outline shape feature in a library 146. Further, a shape-after- machining generating procedure and an expanded-shape generating procedure are stored in the library 146. A local feature and/or an outline shape feature which are selected outside are inputted from an input device 110. A generation part 137 generates a model 114 from the inputted local feature. On the basis of the inputted outline shape feature, and the shape-after-machining generating procedure and expanded shape generating procedure, the shape of a component after machining and its expanded shape are generated by a generation part 135 to obtain a model 143. The cost of the component is calculated on the basis of the model 144 and model 143.



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## CLAIMS

[Claim(s)]
[Claim 1] In the design exchange equipment which computes cost required in order to process said component based on the feature which is the processing approach for generating the quality of the material of the components in a product, and said component The partial feature library where two or more information related with punching processing which is the processing approach performed among the processing approaches for generating said component using specific metal mold was described as a partial feature, respectively, The information about the quality of the material for generating said component, and the information about the processing approach of not using metal mold among the processing approaches for generating said component, Two or more information related with nibbling processing which is the processing approach performed using general-purpose metal mold among the processing approaches for generating said component is described as an outline configuration feature, respectively. And the configuration generation procedure after processing which generates the configuration after processing which is a configuration of each part article after processing specified by each ****** configuration feature, The outline configuration feature library where the extensive form-like generation procedure which generates the shape of an extensive form which is a configuration which developed each part article after processing specified by said outline configuration feature was described, A display means to display each partial feature described by said partial feature library and each outline configuration feature described by said outline configuration feature library, A receptionist means to receive selection of a partial feature and/or an outline configuration feature from from among the partial feature displayed on this display means, and an outline configuration feature, The partial feature generation section which generates the partial feature model which is a model which expresses the contents of application on the components for a design of the processing approach specified by the partial feature of said component based on the selected partial feature, A partial feature model storage means to memorize the partial feature model generated by this partial feature generation section, It is based on the selected outline configuration feature, and the configuration generation procedure after processing and extensive form-like generation procedure which said outline configuration feature library has. The configuration of the components obtained when the processing approach specified by the outline configuration feature chosen as the ingredient of the quality of the material specified by the selected outline configuration feature is applied, The outline configuration generation section which generates the outline geometric model which is a model showing the shape of an extensive form of the components obtained when the processing approach specified by the outline configuration feature chosen as the ingredient of the quality of the material specified by the selected outline configuration feature is applied, An outline geometric model storage means to memorize the outline geometric model generated by this outline configuration generation section, The partial feature model memorized by said partial feature model storage means, A cost factor generation means to generate the factor about cost required in order to generate said component based on the outline geometric model memorized by said outline geometric model storage means, A criteria cost-data storage means to match the factor generated by this cost factor generation means, and cost, and to memorize as criteria cost data, The cost estimated

means which estimates the cost of said component based on the factor generated by said cost factor generation section and the criteria cost data memorized by said criteria cost-data storage means, Design exchange equipment characterized by having the control means which displays the cost of said component estimated with this cost estimated means on said display means.

[Claim 2] In design exchange equipment according to claim 1 said partial feature library It has partial configuration data showing the configuration after processing processed by the processing approach specified by the partial feature described by the partial feature library concerned for every partial feature. Design exchange equipment characterized by having a synthetic means to compound the partial configuration data corresponding to said selected partial feature, and the configuration of the components of said outline geometric model or the shape of an extensive form of the components of said outline geometric model.

[Claim 3] The sub-assembly article or components which constitute a product in design exchange equipment according to claim 1, A means to memorize the configuration table showing the components which constitute said sub-assembly article, and a means to memorize the assembly cost information about cost required in order to assemble a sub-assembly article or components, Design exchange equipment characterized by having a means to compute cost required in order to add the cost of each part article estimated with said cost estimated means based on said configuration table, to add said assembly cost information further and to generate a product.

[Claim 4] In the punch press equipment which performs punching processing which is the processing approach performed among the processing approaches for generating components using specific metal mold, and nibbling processing which is the processing approach performed using general-purpose metal mold The 1st feature library described considering the information about punching processing as the 1st feature, The 2nd feature library described considering the information about nibbling processing as the 2nd feature, The 1st feature described by said 1st feature library, A display means to display the 2nd feature described by said 2nd feature library, A receptionist means to receive selection of the 1st feature and/or the 2nd feature among the 1st feature displayed on this display means, and the 2nd feature, Punch press equipment characterized by performing punching processing and/or nibbling processing based on the 1st selected feature and/or 2nd selected feature.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to design exchange equipment. It is related with the design exchange equipment which promotes a low cost-ized design by showing a designer the manufacturing cost for a design in a sheet-metal design especially.
[0002]
[Description of the Prior Art] In the sheet-metal design, equipment given in JP,4-267484,A and equipment given in JP,5-282331,A are known as design exchange equipment aiming at exchange of a cost estimated activity.
[0003] Cost estimated equipment given in JP,4-267484,A estimates cost using processing element information and criteria cost information from the development view graphic data (extensive form-like data) of the sheet-metal components held as CAD data. This does not need the engineer well versed in the sheet-metal-work method, but there is also no artificial mistake, an engineer's activity man day is reduced, and the effectiveness of the cost estimated activity of sheet-metal components can be improved.

[0004] Moreover, components cost estimated equipment given in JP,5-282331,A can reduce the parameter input time amount for cost count by having the function to extract the parameter about the processing cost of components from CAD configuration data.
[0005]
[Problem(s) to be Solved by the Invention] In cost estimated equipment given [ above-mentioned ] in JP,4-267484,A, in order to estimate cost, a user needs to create the extensive form-like data of sheet-metal components beforehand. However, since the designer who is a user was plotting only the configuration after processing of components, he needed to input extensive form-like CAD data separately and had usually taken time and effort.
[0006] Moreover, since the information about the graphic data (after [ processing ] configuration data) of the configuration after processing of components to cost was extracted in the components cost estimated equipment of extensive form-like data to JP,5-282331,A in cost estimated equipment given in JP,4-267484,A, the class of information which can be extracted had a limit. Moreover, the extract algorithm was complicated.
[0007] Then, it is effective to generate the CAD data of the extensive form-like data of components automatically from the CAD data of the configuration after processing of the components which a designer inputs, and to extract the information about cost from both the CAD data of the configuration after processing and extensive form-like CAD data. As an approach of deriving the CAD data of the shape of an extensive form of components from the CAD data of the configuration after processing of components, although ":Japan Society for precision Engineering besides development:****** of the bending activity automatic process design system of a sheet-metal product, Vol.54, No.11" (1988) are known By coordinate transformation, although this is effective in the components which are the approaches of rotating as a core and are manufactured by linear bending in a bending line, the

monotonous part of a sheet metal The CAD data of the shape of an extensive form of the components which have the burring configuration part manufactured by press working of sheet metal and a diaphragm configuration part are ungenerable.
[0008] Furthermore, generally, although the profile configuration of the shape of an extensive form of components is processed by NC turret punch press equipment Since the class and size of punch metal mold of NC turret punch equipment which works hold are not taken into consideration in the estimate of the processing cost in this processing process, The punching processing part processed by specific punch metal mold and the nibbling processing part processed using general-purpose punch metal mold, such as square shape punch, could not be distinguished, and processing cost could not be estimated, but the fall of estimated precision was caused.
[0009] In design exchange equipment, this invention is equipped with the function which derives the CAD data of the shape of an extensive form of components from the CAD data of the configuration after processing of the components which the user inputted, and aims at estimating the cost of components from the CAD data of the configuration after processing, and extensive form-like CAD data.
[0010] Furthermore, this invention is equipped with the library about the class and size of punch metal mold of NC turret punch press equipment which works hold in design exchange equipment. By distinguishing the punching processing part processed by specific punch metal mold, and the nibbling processing part processed using general-purpose punch metal mold, such as square shape punch, and managing CAD data While simplifying the algorithm for extracting or generating the information about the cost of components, it aims at realizing improvement in the precision of the cost estimate of components.
[0011] That is, a highly precise cost estimate is immediately performed from the CAD data of the components which the user inputted, and the design exchange equipment which supports a low cost-ized design is offered.
[0012]
[Means for Solving the Problem] In the design exchange equipment which computes cost required in order to process said component based on the feature which is the processing approach for generating the quality of the material of the components in a product, and said component according to this invention in order to solve the above-mentioned technical problem The partial feature library where two or more information related with punching processing which is the processing approach performed among the processing approaches for generating said component using specific metal mold was described as a partial feature, respectively, The information about the quality of the material for generating said component, and the information about the processing approach of not using metal mold among the processing approaches for generating said component, Two or more information related with nibbling processing which is the processing approach performed using general-purpose metal mold among the processing approaches for generating said component is described as an outline configuration feature, respectively. And the configuration generation procedure after processing which generates the configuration after processing which is a configuration of each part article after processing specified by each ****** configuration feature, The outline configuration feature library where the extensive form-like generation procedure which generates the shape of an extensive form which is a configuration which developed each part article after processing specified by said outline configuration feature was described, A display means to display each partial feature described by said partial feature library and each outline configuration feature described by said outline configuration feature library, A receptionist means to receive selection of a partial feature and/or an outline configuration feature from from among the partial feature displayed on this display means, and an outline configuration feature, The partial feature generation section which generates the partial feature model which is a model which expresses the contents of application on the components for a design of the processing approach specified by the partial feature of said component based on the selected partial feature, A partial feature model storage means to memorize the partial feature model generated by this partial feature generation section, It is based on the selected outline configuration feature, and the configuration generation procedure after processing and extensive form-like generation procedure which said outline configuration feature library

has. The configuration of the components obtained when the processing approach specified by the outline configuration feature chosen as the ingredient of the quality of the material specified by the selected outline configuration feature is applied, The outline configuration generation section which generates the outline geometric model which is a model showing the shape of an extensive form of the components obtained when the processing approach specified by the outline configuration feature chosen as the ingredient of the quality of the material specified by the selected outline configuration feature is applied, An outline geometric model storage means to memorize the outline geometric model generated by this outline configuration generation section, The partial feature model memorized by said partial feature model storage means, A cost factor generation means to generate the factor about cost required in order to generate said component based on the outline geometric model memorized by said outline geometric model storage means, A criteria cost-data storage means to match the factor generated by this cost factor generation means, and cost, and to memorize as criteria cost data, The cost estimated means which estimates the cost of said component based on the factor generated by said cost factor generation section and the criteria cost data memorized by said criteria cost-data storage means, It can have the control means which displays the cost of said component estimated with this cost estimated means on said display means.

[0013]

[Function] In the design exchange equipment which computes cost required according to this invention in order to process said component based on the feature which is the processing approach for generating the quality of the material of the components in a product, and said component Two or more information related with punching processing which is the processing approach performed among the processing approaches for generating said component using specific metal mold It describes to a partial feature library as a partial feature, respectively. The information about the quality of the material for generating said component, and the information about the processing approach of not using metal mold among the processing approaches for generating said component, Two or more information related with nibbling processing which is the processing approach performed using general-purpose metal mold among the processing approaches for generating said component is described to an outline configuration feature library as an outline configuration feature, respectively. And the extensive form-like generation procedure which generates the shape of an extensive form which is a configuration which developed each part article after the configuration generation procedure after processing which generates the configuration after processing which is a configuration of each part article after processing specified by each ****** configuration feature, and processing specified by said outline configuration feature is described to an outline configuration feature library.

[0014] Each partial feature described by said partial feature library and each outline configuration feature described by said outline configuration feature library are displayed on a display means.

[0015] From from, selection of a partial feature and/or an outline configuration feature is received with a receptionist means among the partial feature displayed on this display means, and an outline configuration feature.

[0016] Based on the selected partial feature, the partial feature generation section generates the partial feature model which is a model showing the contents of application on the components for a design of the processing approach specified by the partial feature of said component.

[0017] The partial feature model generated by this partial feature generation section is memorized with a partial feature model storage means.

[0018] It is based on the selected outline configuration feature, and the configuration generation procedure after processing and extensive form-like generation procedure which said outline configuration feature library has. The configuration of the components obtained when the processing approach specified by the outline configuration feature chosen as the ingredient of the quality of the material specified by the selected outline configuration feature is applied, The outline configuration generation section generates the outline geometric model which is a model showing the shape of an extensive form of the components obtained when the processing approach specified by the outline configuration feature chosen as the ingredient of the quality of the material specified by the selected

outline configuration feature is applied.
[0019] The outline geometric model generated by this outline configuration generation section is memorized with an outline geometric model storage means.
[0020] Based on the partial feature model memorized by said partial feature model storage means and the outline geometric model memorized by said outline geometric model storage means, a cost factor generation means generates the factor about cost required in order to generate said component.
[0021] The factor generated by this cost factor generation means and cost are matched, and it memorizes for a criteria cost-data storage means as criteria cost data.
[0022] Based on the factor generated by said cost factor generation section and the criteria cost data memorized by said criteria cost-data storage means, the cost of said component is estimated with a cost estimated means.
[0023] The cost of said component estimated with this cost estimated means is displayed on said display means by the control means.
[0024]
[Example] One example of this invention is shown below.
[0025] Drawing 1 is drawing explaining the configuration of the design exchange equipment 100 of this invention, and explains the configuration of equipment based on this drawing. Design exchange equipment 100 consists of the input devices 110, such as a keyboard and a mouse, indicating equipments 120, such as CRT and a liquid crystal display, a processing unit 130, and data storage 140.
[0026] The processing unit 130 is equipped with the input-process section 131, the display process section 132, the feature generation section 133, the feature Management Department 134, the outline configuration generation section 135, the outline configuration Management Department 136, the partial feature generation section 137, the partial feature Management Department 138, the cost factor generation section 139, and the cost estimated section 1310.
[0027] Data storage 140 has memorized the CAD data 141, the feature library 145, and the criteria cost data 148. The CAD data 141 are data about the components which a user inputs, and consist of a feature model 142, an outline geometric model 143, and a partial feature model 144. The feature library 145 is data prepared by a system administrator or the system-construction person, and consists of an outline configuration feature library 146 and a partial feature library 147.
[0028] The design of the components of a configuration as shown in drawing 2 is taken for an example, and the principle of operation of the design exchange equipment of this invention is explained below.
[0029] The components of the configuration shown in drawing 2 are processed according to a processing process as shown in drawing 3 . At an expansion processing process, it is processed from a material configuration to the shape of an extensive form. At a press and a bending process, it is processed from the shape of an extensive form to the configuration after processing.
[0030] There is the processing approach of punching processing and nibbling processing in an expansion processing process. Punching processing is shown in drawing 4 (a), and nibbling processing is shown in drawing 4 (b).
[0031] Punching processing is the processing approach by the punch metal mold of specific NC turret punch press equipment corresponding to a specific shape facility part. Generally, when the configuration and size of a processing part are defined standardly, punching processing is performed using the punch metal mold corresponding to it. In this example, a part for the burring hole for tapping screws is processed for the notch part for bolts using the punch metal mold for prepared holes of the punch for tapping screw holes, and the punch metal mold for burring using a bolthole and the punch metal mold for notches.
[0032] On the other hand, as shown in drawing 4 (b), nibbling processing is the processing approach which changes a location little by little and punches general-purpose punch metal mold, such as square shape punch and round shape punch, one after another. Generally, nibbling processing is performed to the processing part as which the configuration or size of a processing part are not determined standardly.

[0033] The design exchange equipment 100 of this invention is used for drawing 5 , and the operating

procedure which inputs the CAD data of the components shown in drawing 2 is shown. By performing feature (shape facility) generation actuation shown in left-hand side in drawing 5 , the CAD data of the components which carried out the configuration shown in right-hand side are generated. That is, the user inputs the CAD data of components by generating a feature one after another and adding it.
[0034] The class of generable feature has for example, a rectangle orientation plate, a rectangle addition plate, an indeterminate form orientation plate, a rectangle notch, an indeterminate form notch, an indeterminate form hole, burring, a diaphragm, the hole for bolts, a burring hole for tapping screws, a ground mark stamp, etc., and the data about these are stored all over the feature library 145.
[0035] The data about features, such as a rectangle orientation plate, a rectangle addition plate, burring, and a rectangle notch, are stored in the outline configuration feature library 146 for every class of feature. Moreover, the data about features, such as a burring hole for tapping screws, a hole for bolts, and a notch for bolts, are stored in the partial feature library 147 for every class of feature.
[0036] That is, in the processing process by NC turret punch press equipment, a feature is divided into the thing corresponding to the configuration part manufactured by punching processing, and a not corresponding thing, stores in the partial feature library 147 the data about the feature corresponding to the configuration part manufactured by punching processing, and stores the data about a not corresponding feature in the outline configuration feature library 146.
[0037] Moreover, the outline configuration feature library 146 is equipped with the configuration generation procedure after processing, and the extensive form-like generation procedure for every class of feature.
[0038] The display process section 132 displays the class of data of the feature stored in the outline configuration library 146 and the partial feature library 147 in the feature library 145 on a display 120 as a feature generation actuation menu.
[0039] A user chooses the class of feature to generate from the feature generation actuation menu displayed on the indicating equipment 120 using an input device 110, and inputs the item further defined beforehand according to the feature class. There are "size", "parent feature assignment", and "tab control specification" in the item inputted.
[0040] The procedure in the input-process section is shown in drawing 6 .
[0041] In processing 601, the class of feature to generate is determined according to a user's selection input.
[0042] Input process of feature size is performed in processing 602. For example, in generation actuation of a rectangle orientation plate, "board thickness", "die length", and "width of face" are inputted, and "bolt size" is inputted in generation actuation of the hole for bolts. There are what is chosen from the size menu displayed on the display 120 like the "bolt size" of the hole generation actuation for bolts, and a thing inputted with a real number value like the "die length" of rectangle orientation plate generation actuation and "width of face" in these.
[0043] In processing 603, input process of the feature assignment which serves as parents is performed. In this example, all the features except a rectangle orientation plate and an indeterminate form orientation plate are inputted depending on the feature of the already inputted components. The feature of this already inputted component is called a parent feature. For example, the parent feature of the corner R of drawing 5 is a rectangle orientation plate, the parent feature of a rectangle addition plate is a rectangle notch, and the parent feature of the notch for bolts is a rectangle addition plate.
[0044] Input process of tab control specification is performed in processing 604. Tab control specification is assignment of the location and posture which generate a feature.
[0045] In processing 605, feature addition generation processing of the feature generation section 133 is started.
[0046] The feature generation section 133 generates the data stored in the feature model 142, and performs processing called the reference and updating of data which are stored in the feature model 142 using the feature Management Department 134 which manages the feature model 142.
[0047] The data stored in the feature model 142 are data about the feature which constitutes the components which the user inputted, and are shown in drawing 7 by making into an example the case of

the components shown in drawing 2 .
[0048] Each feature is expressed by the data item of a "class", "size", "system of coordinates", a "parent feature", and a "relative position." The "class" shows the class of the feature. "Size" shows the size of a feature with the expression depending on the class of the feature. "System of coordinates" expresses the system of coordinates of a proper to the feature by the transformation matrix, and is computed from the location and posture of a feature which it was inputted by the user. The "parent feature" shows depending on which feature the feature is generated according to the input from a user. A "relative position" is the coordinate value which expressed the location of the feature with the system of coordinates of a parent feature. A "class", "size", and a "parent feature" are inputted by the user.
[0049] The procedure of feature addition generation processing in the feature generation section 133 is shown in drawing 8 .
[0050] In processing 801, the relative position of a feature is computed from the location of the feature obtained in the tab-control-specification input from the system-of-coordinates data and the user of a parent feature.
[0051] In processing 802, the system of coordinates of a feature are computed based on the posture of the feature obtained in the tab-control-specification input from a user.
[0052] In processing 803, the relative position of the feature class inputted by the user, size, a parent feature, and the feature required in processing 801 and the system of coordinates of the feature required in processing 802 are registered to the feature model 142 through the feature model Management Department 134.
[0053] In processing 804, the feature performs the judgment of an outline configuration feature or a partial feature from a feature class.
[0054] When judged with an outline configuration feature, it progresses to processing 805, the outline configuration generation section 135 is started, and configuration generation processing of an outline configuration feature is performed. The configuration of the generated outline configuration feature is stored in the outline geometric model 143 through the outline configuration Management Department 136. About this processing 805, it mentions later using drawing 12 (a).
[0055] On the other hand, when judged with a partial feature by processing 804, it progresses to processing 806, the outline configuration generation section 135 is started, and configuration generation processing of the approximation outline configuration reflecting a partial configuration is performed. The configuration of the approximation outline configuration reflecting the generated partial configuration is stored in the outline geometric model 143 through the outline configuration Management Department 136. About this processing 806, it mentions later using drawing 12 (b). Furthermore, the partial feature model generation section 137 is started by processing 807, a partial feature model is generated, and registration to the partial feature model 144 is performed through the partial feature model Management Department 138.
[0056] The outline configuration generation section 135 performs processing about generation of the configuration of each feature.
[0057] As an approach of managing three-dimension configurations, such as a machine part, it is ""Geometric modelling, for example. : Various approaches are learned as indicated by a survey", A Baer, C Eastman and M Henrion, Computer-Aided Design, Vol.11, No.5, (1979), and pp.253-272."
[0058] Here, the management method of the configuration of the three dimension based on a general boundary representation method (B-Reps) is explained. A three-dimension configuration is expressed by five kinds of configuration elements, a solid element, a field element, a circumferential element, a ridgeline element, and a top-most-vertices element, and is managed.
[0059] For example, the boundary of the interior and the exterior of a solid element shown in drawing 9 (a) is expressed by one or more field elements as shown in drawing 9 (b). Furthermore, the boundary of the interior and the exterior of a field element is expressed by one or more circumferential elements as shown in drawing 9 (c). In this example, the boundaries of the field element 1 are the circumferential element 1 and the circumferential element 2, and the boundary of the field element 2 is the circumferential element 3.

[0060] The boundary of a circumferential element is expressed by one or more ridgeline elements as shown in drawing 9 (d). In this example, the ridgeline element 1 and ridgeline element 2 grade are the boundaries of the circumferential element 1. The boundary of a ridgeline element is expressed by the top-most-vertices element as shown in drawing 9 (e). In this example, the boundaries of the ridgeline element 1 are the top-most-vertices element 1 and the top-most-vertices element 2, and the boundaries of the ridgeline element 2 are the top-most-vertices element 2 and the top-most-vertices element 3. In this example, the top-most-vertices element 2 is also the boundary of the ridgeline element 1, and is also the boundary of the ridgeline element 2. Moreover, the ridgeline element 1 is also the boundary of the circumferential element 1, and is also the boundary of the circumferential element 3.
[0061] Therefore, these solid elements, a field element, a circumferential element, a ridgeline element, and a top-most-vertices element are managed as a network as shown in drawing 10 based on each adjacency.
[0062] The outline configuration Management Department 136 manages the outline geometric model 143 according to DS like drawing 10 , and is expressing the configuration of components. The outline configuration generation section 135 generates a configuration element for change of the configuration by the actuation which the designer performed on DS like drawing 10 , deletes it, corrects the geometric data currently held for every configuration element, or corrects network connection relation, and makes it reflected using the outline configuration Management Department 136.
[0063] the configuration part corresponding to a partial feature on the basis of the approach of managing a configuration by using as a configuration element the solid element which is the above-mentioned approach, a field element, a circumferential element, a ridgeline element, and a top-most-vertices element at the outline geometric model 143 of this invention, and the outline configuration Management Department 136 -- approximation -- it omitted and expressed-like and has the description of managing as an outline configuration. That is, the ridgeline element of the outline geometric model 143 extended the ridgeline element of the conventional geometric model, and is equipped with the partial feature section flag with the ridgeline part identifiable whether it is the ridgeline which corresponded to the partial feature part and was expressed in approximation. The extract algorithm of a cost factor is simplified by having this description. About the processing algorithm of configuration generation or configuration correction, things can perform using the approach of the conventional configuration management.
[0064] The outline configuration which in the case of the components shown in drawing 2 was approximated as shown in drawing 11 (a) is stored in the outline geometric model 143. Moreover, the shape of an extensive form shown in the middle of drawing 3 is similarly approximated like drawing 11 (b) as an outline configuration. In drawing 11 , the thick wire showed the ridgeline which expressed the partial feature in approximation. namely, the configuration part corresponding to the notch for bolts and the burring hole for tapping screws which are the partial feature which appears in drawing 2 -- approximation -- it is omitted and expressed-like. Like the burring hole for tapping screws, in the case of the partial feature of a field addition mold, it is omitted and is expressed by the approximation ridgeline element by partial features other than a field addition mold like the notch for bolts which is the partial feature of an edge addition mold.
[0065] The procedure about configuration generation processing in the outline configuration generation section 135 is divided when related with the case where it is related with an outline configuration feature, and a partial feature, and it is shown in drawing 12 (a) and drawing 12 (b).
[0066] In configuration generation processing of an outline configuration feature, it progresses to processing 1201, and searches and asks for the configuration generation procedure after processing from the outline configuration feature library 146. Next, in processing 1202, based on the called-for configuration generation procedure after processing, configuration generation processing of an outline configuration feature is performed, the outline geometric model Management Department 135 is started, and it stores in the outline geometric model 143.
[0067] In configuration generation processing of a partial feature, it progresses to processing 1203 and the feature judges whether it is the feature of a field addition mold, it is the feature of an edge addition

mold, or it is the feature of an angle addition mold based on a feature class. It seems that the feature of an angle addition mold is shown in drawing 13 (c) as the feature of a field addition mold is shown in drawing 13 (a) and the feature of an edge addition mold is shown in drawing 13 (b).

[0068] Based on this judgment result, if it is an edge addition mold, and it is an angle addition mold, it will progress to processing 1204 at processing 1205, respectively. It does not process, especially when judged with it being the feature of a field addition mold. In processing 1204, the outline configuration generation section 135 is started and outline configuration processing for edge addition mold partial features is performed. In processing 1205, the outline configuration generation section 135 is started and outline configuration processing for angle addition mold partial features is performed.

[0069] Here, since the generation procedures of the data expressing the configuration in the outline geometric model 143 differ for every class of feature in the case of an outline configuration, a configuration generation procedure is prepared for every feature class, and it is stored all over the feature library.

[0070] On the other hand, in the case of a partial feature, the generation procedure of the data expressing the configuration in the outline geometric model 143 is two kinds, an edge addition mold and an angle addition mold, and even if the class of new feature is added, it does not change. For example, in the case of an edge addition mold, even if it is V notch shown in the drawing 13 (b) right-hand side even if the class of feature was the notch for bolts shown in the drawing 13 (b) left-hand side, it is expressed by the same procedure so that it may be the thick wire part of drawing 11 .

[0071] The partial feature generation section 137 manages the partial feature model 144 using the partial feature Management Department 138, and performs processing called the generation of data, reference, and updating which are stored in the partial feature model 144.

[0072] The data stored in the partial feature model 144 are data about the partial feature contained in the components which the user inputted, and express the abbreviation or the part currently expressed in approximation in the outline geometric model 143.

[0073] The contents of the partial feature model 144 are shown in drawing 14 by making into an example the case of the components shown in drawing 2 . Each partial feature is expressed by the data item of "Feature ID", a "location", and a "posture." "Feature ID" shows the feature to which it corresponds in the feature model 142. A "location" expresses the location of a feature with the coordinate value on the absolute coordinate system of a three dimension. A "posture" expresses the posture of a feature by two direction vectors with which it intersects perpendicularly on the absolute coordinate system of a three dimension.

[0074] The procedure of partial feature registration processing in the partial feature generation section 137 is shown in drawing 15 . In processing 1501, the location and posture of a feature on the absolute coordinate system of three-dimension space are searched for. A location is called for using the relative position of 142 in a feature model, and the system of coordinates of a parent feature. A posture is searched for using the posture in the feature model 142, and the system of coordinates of a parent feature. In processing 1502, registration to the partial feature model 144 is performed using the partial feature Management Department 138.

[0075] The display-processing section 132 displays the configuration of the components which the user inputted on a display 120. The procedure in the display-processing section 132 is shown in drawing 16 </A> .

[0076] In processing 1601, the geometric data of the ridgeline of an outline configuration feature part are taken out from the outline geometric model 143. This distinguishes the ridgeline element which expressed the configuration part corresponding to a partial feature in approximation from the outline geometric model 143 using a partial feature section flag, and is performed by taking out the geometric information about all the ridgeline elements except the ridgeline element which approximated the configuration part corresponding to a partial feature.

[0077] In processing 1602, a partial feature is taken out sequentially from the partial feature model 144. Here, if processing 1603 - processing 1605 have already been performed to all partial features, it will progress to processing 1606. If the partial feature to which processing 1603 - processing 1605 are not

performed is taken out, it will progress to processing 1603.
[0078] In processing 1603, it asks for the class and size of a partial feature which were chosen as a processing object by processing 1602 using the data of the feature ID in the partial feature model 144, and the data of the feature class in the feature model 142, and the geometric data of the class of partial feature and the ridgeline element currently beforehand prepared for every size are taken out out of the partial feature library 147.
[0079] In processing 1604, coordinate transformation is performed to the geometric data of the ridgeline element of a partial feature taken out by processing 1603 using the location data and posture data in the partial feature model 144.
[0080] In processing 1605, the geometric data of the ridgeline element of the partial feature by which coordinate transformation was carried out by processing 1604 are compounded to the geometric data of the ridgeline element of the configuration part corresponding to the outline configuration feature obtained by processing 1601.
[0081] After processing 1605 is completed, it returns to processing 1602 and the following processing object is chosen. After processing 1603 - processing 1605 are performed to all the partial features contained in the components which the user inputted, it progresses to processing 1606. In processing 1606, coordinate transformation according to an eye direction is performed to the geometric data of the ridgeline element obtained by processing 1601 - processing 1605.
[0082] In processing 1607, the configuration of the components which the user inputted into the display 120 using the geometric data of the ridgeline element by which coordinate transformation was carried out by processing 1606 is displayed.
[0083] Based on the CAD data 141 of the components which the user inputted, the cost factor generation section 139 asks for the cost factor which is required information, when computing the cost of the component.
[0084] The outline of the procedure in the cost factor generation section 139 is shown in drawing 17 .
[0085] In processing 1701, the outline geometric model 143 and the partial feature model 144 about the shape of an extensive form of components are generated from the feature model 142.
[0086] In processing 1702, it asks for a cost factor from the partial feature model 144 about the shape of an extensive form of the components generated by processing 1701. The cost factor required in processing 1702 is data about the punching processing part which used NC turret punch press equipment. Since a punching processing part is processed by specific punch metal mold, the class and the count of punch of punch metal mold serve as a cost factor. Since the punching processing part contained in the components which the user inputted is specified by the partial feature model 144 and correspondence with the class of partial feature and size is beforehand registered into the partial feature library 147, the class and the count of punch of punch metal mold are called for easily. In the case of the components of drawing 2 , into the partial feature model 144, the notch for bolts and every one burring hole for tapping screws are registered. as shown in drawing 4 , the notch part for bolts is processed with the punch metal mold a bolthole and for notches -- having -- a part for the burring hole for tapping screws -- the prepared hole of the punch metal mold for tapping screw holes -- public funds -- a mold and burring -- public funds -- it turns out that being processed with a mold is registered all over the partial feature library 147, and three kinds of such punch metal mold is used by a unit of 1 time, respectively. Naturally, such correspondence of a partial feature and punch metal mold is registered for every size of a partial feature.
[0087] In processing 1703, it asks for a cost factor from the outline geometric model 143 about the shape of an extensive form of the components generated by processing 1701. The cost factors required in processing 1703 are the data about a stock size, data about the nibbling processing part using NC turret punch press equipment, etc. The data about a stock size are the area of a material, die length, width of face, the value of board thickness, etc., and are obtained by asking for the minimum rectangular parallelepiped which carries out the epicyst of the shape of an extensive form of components simply. Furthermore, it can also ask for the data about a stock size more correctly by comparing the dimension of the minimum rectangular parallelepiped which carries out epicyst to the data about the dimension of

the purchased material. Moreover, about board thickness, it is obtained from the feature model 142 also by the approach of searching for directly.

[0088] In order to process it about the nibbling processing part using general-purpose punch metal mold, such as a square shape, one side of the punch metal mold used for processing with processing profile length can be asked for the count of punch from die length, and this serves as a cost factor. Selection of the punch metal mold used for processing and calculation of processing profile length are performed based on the ridgeline element which constitutes a profile configuration.

[0089] Here, the example at the time of using the outline geometric model 143 and the partial feature model 144 which are the description of this invention at drawing 18 (a) and (c) about the example at the time of using the conventional geometric model which is distinguishing and expressing the punching processing part and the nibbling processing part is shown in drawing 18 (c) and (d).

[0090] Here, like drawing 18 (a), when the conventional geometric model was used, since the punching processing part and the nibbling processing part were not distinguished and were expressed, there was a trouble of selecting small punch metal mold superfluously, in response to the effect of a punching processing part. For example, in the case of drawing 18 (a), if square shape punch metal mold with long die length of one side is used from a dimension B, it will be judged [ that it is not processible and ], and punch will be assigned like drawing 18 (c). However, in fact, since the part of the notch for bolts is processed using a bolthole and the punch metal mold for notches as shown in drawing 4 R> 4 (a), die length of one side can process it by square shape punch of A like drawing 18 (d).

[0091] Moreover, there was a trouble of being computed otherwise by the die length in which profile length contained the punching part. With the design exchange equipment 100 of this invention, selection of punch metal mold and calculation of profile length can be correctly performed by the simple approach by using the outline geometric model 143 and the partial feature model 144. The punch metal mold quota approach of NC turret punch press equipment of above-mentioned this invention is available also as automatic-programming generation equipment of NC turret punch press equipment.

[0092] In processing 1704, the outline geometric model 143 and the partial feature model 144 about the configuration after processing of components are generated.

[0093] In processing 1705, it asks for a cost factor from the outline geometric model 143 about the configuration after processing of the components generated by processing 1704. The cost factor required in processing 1705 is data about bending and press working of sheet metal. For example, there are a count of bending, the direction of each bending, the die length of an angle of bend and a bending line, etc. in the cost factor about bending. Moreover, there are the direction of [ for a converging section / the number and each burring part for a converging section, such as a burring part, etc. ], the depth, profile length, etc. in the cost factor about press working of sheet metal.

[0094] In asking from the geometric model which distinguished and expressed a partial configuration part and other configuration parts like before by using the outline geometric model 143 also when asking for these data Although there was a problem that an algorithm became complicated in order to incorrect-recognize the burring hole for tapping screws, and the local processing part carry out louvering and according to punching processing like a configuration to be a press-working-of-sheet-metal part and a bending part, respectively or to prevent incorrect recognition These problems are solvable.

[0095] For example, by carrying out louvering, in the case of a configuration, the size is comparatively small, and a thing like drawing 19 (a) by which size is standardized can be processed using NC turret punch press, and if such punch metal mold corresponding to [ carry out louvering and ] a configuration part is prepared, it can create by punching processing. In such a case, it sets, and if the conventional geometric model which distinguishes and expresses a partial configuration part and other configuration parts is used, punch metal mold will be assigned to a part like drawing 19 (b) in the shape of an extensive form as nibbling processing, and a misjudgment law will be carried out to 1 more time of a bending process or a press process being required.

[0096] In this invention, if such punch metal mold corresponding to [ carry out louvering and ] a configuration part is prepared, since it registers with the partial feature library 147 as a partial feature of a field addition mold, a cost factor is outputted correctly. Since it cannot choose from the menus

displayed on a designer reflecting the class and size of a feature which are not registered into the partial feature library 147, but are registered into the partial feature library 147 when it is the size for which punch metal mold is not prepared, a designer will input using the rectangle hole and rectangle addition plate which are an outline configuration feature. in this case -- this -- louvering is carried out, and a configuration part is also expressed on the outline geometric model 143, assigns punch metal mold as nibbling processing, and is correctly judged as one more bending or press working of sheet metal being required.

[0097] The procedure in the generation procedure of the outline geometric model 143 which is components data about the generation procedure of the outline geometric model 143 which is components data about the shape of an extensive form started by processing 1701, and the partial feature model 144, and the configuration after processing started by processing 1704, and the partial feature model 144 is shown in drawing 20 .

[0098] In processing 2001, the feature by which the feature of the class of the rectangle orientation plate with which a parent feature does not exist, or indeterminate form orientation plate, or the parent feature is already processed is chosen from the feature model 142 as a processing object.

[0099] Processing is ended when all the features in the feature model 142 are processed. In processing 2002, processing of the processing 802 of drawing 8 - processing 807 performs the re-calculation and updating of data which are related to the feature chosen as a processing object by processing 2001. However, in processing 803, a feature is not registered but the data about a processing-object feature are updated. Moreover, in generation processing of the components data about the shape of an extensive form, processing of processing 1201 becomes in the procedure started by processing 805 not with retrieval of the configuration generation procedure after processing but with retrieval of an extensive form-like generation procedure. That is, both the configuration generation procedure after processing and the extensive form-like generation procedure are described by the outline configuration feature library 146, and, not only the case of the components processed by linear bending by this but in the case of the components with a part for the burring part of components as shown in drawing 2 , and a converging section processed by press working of sheet metal, extensive form-like components data can be generated.

[0100] Here, the after [ processing ] configuration generation procedure of the burring part of components as shown in drawing 2 , and an extensive form-like generation procedure are taken for an example, and it is shown in drawing 21 and drawing 22 .

[0101] In processing 2101, it asks for the ridgeline element group to which a burring feature is added out of the outline geometric model 143. That is, it asks for the ridgeline part of drawing 22 (b) out of the outline geometric model 143 showing the configuration shown in drawing 22 (a).

[0102] Next, in generating the configuration after processing, it attaches the thickness for board thickness by processing 2102 on the flat surface where it belongs a ridgeline element group. Thereby, a two-dimensional configuration like drawing 22 (c) is acquired.

[0103] Next, by processing 2103, the sweep of the two-dimensional configuration of drawing 22 (c) is carried out in the height specified in the direction of a normal of the flat surface where a ridgeline element group belongs, and a solid configuration like drawing 22 (d) is generated.

[0104] On the other hand, in generating the shape of an extensive form, by processing 2104, the sweep of the ridgeline element group is carried out in the height specified in the direction of an outside of the flat surface where it belongs, and it generates the two-dimensional configuration of drawing 22 (f).

[0105] Next, by processing 2105, the thickness for board thickness is attached to the two-dimensional configuration of drawing 22 (f), and a solid configuration like drawing 22 (g) is generated.

[0106] In processing 2106, the solid configuration generated by processing 2103 or processing 2105 is compounded with the original solid configuration, and the solid configuration which added the burring part like drawing 22 (e) and drawing 22 (h) is generated.

[0107] Such a configuration generation procedure after processing and an extensive form-like generation procedure are stored in the outline configuration feature library 146 for every outline configuration feature. Thus, by having the configuration generation procedure after processing, and extensive form-

like generation procedure, an after [ processing ] geometric model and an extensive form-like model are automatically generable from the feature model 142 also in the configuration including burring, a diaphragm, etc. which was not able to respond by the method which performs conversion with the shape of the configuration after processing, and an extensive form more for performing system-of-coordinates conversion.

[0108] The cost estimated section 1310 estimates cost at the cost factor called for by the cost factor generation section 139 from the criteria cost data 148. Although various approaches can be considered in the approach of a cost estimate, it asks by adding the criteria cost value simply set up for every cost factor.

[0109] For example, if data, such as material criteria cost data as shown in drawing 23 R> 3 (a), expansion working standard cost data as shown in drawing 23 (b), and bending working standard cost data as shown at drawing 23 (c), are stored in the criteria cost data 148, it can ask for the cost of components by asking for the cost to each cost factor, and adding them. As material criteria cost data, as shown in drawing 23 (a), the cost per unit area corresponding to the class of board thickness and the class of board thickness is stored, respectively. As expansion working standard cost data, as shown in drawing 2323 (b), the cost per count of punch corresponding to the number of classes of punch metal mold and the number of classes of punch metal mold is stored, respectively. As bending working standard cost data, the die length of a bending line, an angle of bend, and the cost per [ corresponding ] bending are stored in drawing 23 (c) so that it may be shown. The estimated cost value is displayed on a display 120 by the display-processing section 132.

[0110] Generally, the cost estimate of a product or a sub-assembly article is performed using a bill of material report as shown in drawing 24 . The example of drawing 2424 shows that a product 1 consists of a sub-assembly article 1, a sub-assembly article 2, and components 6, the sub-assembly article 1 consists of components 1 and components 2, and the sub-assembly article 2 consists of components 3, components 4, and components 5. Here, the cost of a product 1 is called for as the sum total of the cost which the cost of the sub-assembly article 1, the cost of the sub-assembly article 2, the costs of components 6, and those assembly take. Furthermore, the cost of the sub-assembly article 1 serves as the sum total of the cost which the cost of components 1, the costs of components 2, and those assembly take. Although the cost of each component must be called for by a certain approach, the approach of this invention can be used to sheet-metal components here.

[0111]

[Effect of the Invention] As mentioned above, according to this invention, in design exchange equipment, it can have the function which derives the CAD data of the shape of an extensive form of components from the CAD data of the configuration after processing of the components which the user inputted, and the cost of components can be estimated from the CAD data of the configuration after processing, and extensive form-like CAD data.

[0112] Furthermore, this invention is equipped with the library about the class and size of punch metal mold of NC turret punch press equipment which works hold in design exchange equipment. By distinguishing the punching processing part processed by specific punch metal mold, and the nibbling processing part processed using general-purpose punch metal mold, such as square shape punch, and managing CAD data While simplifying the algorithm for extracting or generating the information about the cost of components, improvement in the precision of the cost estimate of components is realizable.

[0113] That is, a highly precise cost estimate can be immediately performed from the CAD data of the components which the user inputted, and the design exchange equipment which supports a low cost-ized design can be offered.

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TECHNICAL FIELD

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[Industrial Application] This invention relates to design exchange equipment. It is related with the design exchange equipment which promotes a low cost-ized design by showing a designer the manufacturing cost for a design in a sheet-metal design especially.

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PRIOR ART

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[Description of the Prior Art] In the sheet-metal design, equipment given in JP,4-267484,A and equipment given in JP,5-282331,A are known as design exchange equipment aiming at exchange of a cost estimated activity.
[0003] Cost estimated equipment given in JP,4-267484,A estimates cost using processing element information and criteria cost information from the development view graphic data (extensive form-like data) of the sheet-metal components held as CAD data. This does not need the engineer well versed in the sheet-metal-work method, but there is also no artificial mistake, an engineer's activity man day is reduced, and the effectiveness of the cost estimated activity of sheet-metal components can be improved.

[0004] Moreover, components cost estimated equipment given in JP,5-282331,A can reduce the parameter input time amount for cost count by having the function to extract the parameter about the processing cost of components from CAD configuration data.

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EFFECT OF THE INVENTION

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[Effect of the Invention] As mentioned above, according to this invention, in design exchange equipment, it can have the function which derives the CAD data of the shape of an extensive form of components from the CAD data of the configuration after processing of the components which the user inputted, and the cost of components can be estimated from the CAD data of the configuration after processing, and extensive form-like CAD data.
[0112] Furthermore, this invention is equipped with the library about the class and size of punch metal mold of NC turret punch press equipment which works hold in design exchange equipment. By distinguishing the punching processing part processed by specific punch metal mold, and the nibbling processing part processed using general-purpose punch metal mold, such as square shape punch, and managing CAD data While simplifying the algorithm for extracting or generating the information about the cost of components, improvement in the precision of the cost estimate of components is realizable.
[0113] That is, a highly precise cost estimate can be immediately performed from the CAD data of the components which the user inputted, and the design exchange equipment which supports a low cost-ized design can be offered.

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MEANS

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[Means for Solving the Problem] In the design exchange equipment which computes cost required in order to process said component based on the feature which is the processing approach for generating the quality of the material of the components in a product, and said component according to this invention in order to solve the above-mentioned technical problem The partial feature library where two or more information related with punching processing which is the processing approach performed among the processing approaches for generating said component using specific metal mold was described as a partial feature, respectively, The information about the quality of the material for generating said component, and the information about the processing approach of not using metal mold among the processing approaches for generating said component, Two or more information related with nibbling processing which is the processing approach performed using general-purpose metal mold among the processing approaches for generating said component is described as an outline configuration feature, respectively. And the configuration generation procedure after processing which generates the configuration after processing which is a configuration of each part article after processing specified by each ****** configuration feature, The outline configuration feature library where the extensive form-like generation procedure which generates the shape of an extensive form which is a configuration which developed each part article after processing specified by said outline configuration feature was described, A display means to display each partial feature described by said partial feature library and each outline configuration feature described by said outline configuration feature library, A receptionist means to receive selection of a partial feature and/or an outline configuration feature from from among the partial feature displayed on this display means, and an outline configuration feature, The partial feature generation section which generates the partial feature model which is a model which expresses the contents of application on the components for a design of the processing approach specified by the partial feature of said component based on the selected partial feature, A partial feature model storage means to memorize the partial feature model generated by this partial feature generation section, It is based on the selected outline configuration feature, and the configuration generation procedure after processing and extensive form-like generation procedure which said outline configuration feature library has. The configuration of the components obtained when the processing approach specified by the outline configuration feature chosen as the ingredient of the quality of the material specified by the selected outline configuration feature is applied, The outline configuration generation section which generates the outline geometric model which is a model showing the shape of an extensive form of the components obtained when the processing approach specified by the outline configuration feature chosen as the ingredient of the quality of the material specified by the selected outline configuration feature is applied, An outline geometric model storage means to memorize the outline geometric model generated by this outline configuration generation section, The partial feature model memorized by said partial feature model storage means, A cost factor generation means to generate the factor about cost required in order to generate said component based on the outline geometric model memorized by said outline geometric model storage means, A criteria cost-data storage means to match the factor generated by this cost factor generation means, and cost, and to memorize as criteria cost data, The cost estimated

means which estimates the cost of said component based on the factor generated by said cost factor generation section and the criteria cost data memorized by said criteria cost-data storage means, It can have the control means which displays the cost of said component estimated with this cost estimated means on said display means.

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## OPERATION

[Function] In the design exchange equipment which computes cost required according to this invention in order to process said component based on the feature which is the processing approach for generating the quality of the material of the components in a product, and said component Two or more information related with punching processing which is the processing approach performed among the processing approaches for generating said component using specific metal mold It describes to a partial feature library as a partial feature, respectively. The information about the quality of the material for generating said component, and the information about the processing approach of not using metal mold among the processing approaches for generating said component, Two or more information related with nibbling processing which is the processing approach performed using general-purpose metal mold among the processing approaches for generating said component is described to an outline configuration feature library as an outline configuration feature, respectively. And the extensive form-like generation procedure which generates the shape of an extensive form which is a configuration which developed each part article after the configuration generation procedure after processing which generates the configuration after processing which is a configuration of each part article after processing specified by each ****** configuration feature, and processing specified by said outline configuration feature is described to an outline configuration feature library.
[0014] Each partial feature described by said partial feature library and each outline configuration feature described by said outline configuration feature library are displayed on a display means.
[0015] From from, selection of a partial feature and/or an outline configuration feature is received with a receptionist means among the partial feature displayed on this display means, and an outline configuration feature.
[0016] Based on the selected partial feature, the partial feature generation section generates the partial feature model which is a model showing the contents of application on the components for a design of the processing approach specified by the partial feature of said component.
[0017] The partial feature model generated by this partial feature generation section is memorized with a partial feature model storage means.
[0018] It is based on the selected outline configuration feature, and the configuration generation procedure after processing and extensive form-like generation procedure which said outline configuration feature library has. The configuration of the components obtained when the processing approach specified by the outline configuration feature chosen as the ingredient of the quality of the material specified by the selected outline configuration feature is applied, The outline configuration generation section generates the outline geometric model which is a model showing the shape of an extensive form of the components obtained when the processing approach specified by the outline configuration feature chosen as the ingredient of the quality of the material specified by the selected outline configuration feature is applied.
[0019] The outline geometric model generated by this outline configuration generation section is memorized with an outline geometric model storage means.
[0020] Based on the partial feature model memorized by said partial feature model storage means and

the outline geometric model memorized by said outline geometric model storage means, a cost factor generation means generates the factor about cost required in order to generate said component.
[0021] The factor generated by this cost factor generation means and cost are matched, and it memorizes for a criteria cost-data storage means as criteria cost data.
[0022] Based on the factor generated by said cost factor generation section and the criteria cost data memorized by said criteria cost-data storage means, the cost of said component is estimated with a cost estimated means.
[0023] The cost of said component estimated with this cost estimated means is displayed on said display means by the control means.

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EXAMPLE

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[Example] One example of this invention is shown below.
[0025] Drawing 1 is drawing explaining the configuration of the design exchange equipment 100 of this invention, and explains the configuration of equipment based on this drawing. Design exchange equipment 100 consists of the input devices 110, such as a keyboard and a mouse, indicating equipments 120, such as CRT and a liquid crystal display, a processing unit 130, and data storage 140.
[0026] The processing unit 130 is equipped with the input-process section 131, the display process section 132, the feature generation section 133, the feature Management Department 134, the outline configuration generation section 135, the outline configuration Management Department 136, the partial feature generation section 137, the partial feature Management Department 138, the cost factor generation section 139, and the cost estimated section 1310.
[0027] Data storage 140 has memorized the CAD data 141, the feature library 145, and the criteria cost data 148. The CAD data 141 are data about the components which a user inputs, and consist of a feature model 142, an outline geometric model 143, and a partial feature model 144. The feature library 145 is data prepared by a system administrator or the system-construction person, and consists of an outline configuration feature library 146 and a partial feature library 147.
[0028] The design of the components of a configuration as shown in drawing 2 is taken for an example, and the principle of operation of the design exchange equipment of this invention is explained below.
[0029] The components of the configuration shown in drawing 2 are processed according to a processing process as shown in drawing 3 . At an expansion processing process, it is processed from a material configuration to the shape of an extensive form. At a press and a bending process, it is processed from the shape of an extensive form to the configuration after processing.
[0030] There is the processing approach of punching processing and nibbling processing in an expansion processing process. Punching processing is shown in drawing 4 (a), and nibbling processing is shown in drawing 4 (b).
[0031] Punching processing is the processing approach by the punch metal mold of specific NC turret punch press equipment corresponding to a specific shape facility part. Generally, when the configuration and size of a processing part are defined standardly, punching processing is performed using the punch metal mold corresponding to it. In this example, a part for the burring hole for tapping screws is processed for the notch part for bolts using the punch metal mold for prepared holes of the punch for tapping screw holes, and the punch metal mold for burring using a bolthole and the punch metal mold for notches.
[0032] On the other hand, as shown in drawing 4 (b), nibbling processing is the processing approach which changes a location little by little and punches general-purpose punch metal mold, such as square shape punch and round shape punch, one after another. Generally, nibbling processing is performed to the processing part as which the configuration or size of a processing part are not determined standardly.

[0033] The design exchange equipment 100 of this invention is used for drawing 5 , and the operating procedure which inputs the CAD data of the components shown in drawing 2 is shown. By performing

feature (shape facility) generation actuation shown in left-hand side in drawing 5 , the CAD data of the components which carried out the configuration shown in right-hand side are generated. That is, the user inputs the CAD data of components by generating a feature one after another and adding it.
[0034] The class of generable feature has for example, a rectangle orientation plate, a rectangle addition plate, an indeterminate form orientation plate, a rectangle notch, an indeterminate form notch, an indeterminate form hole, burring, a diaphragm, the hole for bolts, a burring hole for tapping screws, a ground mark stamp, etc., and the data about these are stored all over the feature library 145.
[0035] The data about features, such as a rectangle orientation plate, a rectangle addition plate, burring, and a rectangle notch, are stored in the outline configuration feature library 146 for every class of feature. Moreover, the data about features, such as a burring hole for tapping screws, a hole for bolts, and a notch for bolts, are stored in the partial feature library 147 for every class of feature.
[0036] That is, in the processing process by NC turret punch press equipment, a feature is divided into the thing corresponding to the configuration part manufactured by punching processing, and a not corresponding thing, stores in the partial feature library 147 the data about the feature corresponding to the configuration part manufactured by punching processing, and stores the data about a not corresponding feature in the outline configuration feature library 146.
[0037] Moreover, the outline configuration feature library 146 is equipped with the configuration generation procedure after processing, and the extensive form-like generation procedure for every class of feature.
[0038] The display process section 132 displays the class of data of the feature stored in the outline configuration library 146 and the partial feature library 147 in the feature library 145 on a display 120 as a feature generation actuation menu.
[0039] A user chooses the class of feature to generate from the feature generation actuation menu displayed on the indicating equipment 120 using an input device 110, and inputs the item further defined beforehand according to the feature class. There are "size", "parent feature assignment", and "tab control specification" in the item inputted.
[0040] The procedure in the input-process section is shown in drawing 6 .
[0041] In processing 601, the class of feature to generate is determined according to a user's selection input.
[0042] Input process of feature size is performed in processing 602. For example, in generation actuation of a rectangle orientation plate, "board thickness", "die length", and "width of face" are inputted, and "bolt size" is inputted in generation actuation of the hole for bolts. There are what is chosen from the size menu displayed on the display 120 like the "bolt size" of the hole generation actuation for bolts, and a thing inputted with a real number value like the "die length" of rectangle orientation plate generation actuation and "width of face" in these.
[0043] In processing 603, input process of the feature assignment which serves as parents is performed. In this example, all the features except a rectangle orientation plate and an indeterminate form orientation plate are inputted depending on the feature of the already inputted components. The feature of this already inputted component is called a parent feature. For example, the parent feature of the corner R of drawing 5 is a rectangle orientation plate, the parent feature of a rectangle addition plate is a rectangle notch, and the parent feature of the notch for bolts is a rectangle addition plate.
[0044] Input process of tab control specification is performed in processing 604. Tab control specification is assignment of the location and posture which generate a feature.
[0045] In processing 605, feature addition generation processing of the feature generation section 133 is started.
[0046] The feature generation section 133 generates the data stored in the feature model 142, and performs processing called the reference and updating of data which are stored in the feature model 142 using the feature Management Department 134 which manages the feature model 142.
[0047] The data stored in the feature model 142 are data about the feature which constitutes the components which the user inputted, and are shown in drawing 7 by making into an example the case of the components shown in drawing 2 .

[0048] Each feature is expressed by the data item of a "class", "size", "system of coordinates", a "parent feature", and a "relative position." The "class" shows the class of the feature. "Size" shows the size of a feature with the expression depending on the class of the feature. "System of coordinates" expresses the system of coordinates of a proper to the feature by the transformation matrix, and is computed from the location and posture of a feature which it was inputted by the user. The "parent feature" shows depending on which feature the feature is generated according to the input from a user. A "relative position" is the coordinate value which expressed the location of the feature with the system of coordinates of a parent feature. A "class", "size", and a "parent feature" are inputted by the user.
[0049] The procedure of feature addition generation processing in the feature generation section 133 is shown in drawing 8 .
[0050] In processing 801, the relative position of a feature is computed from the location of the feature obtained in the tab-control-specification input from the system-of-coordinates data and the user of a parent feature.
[0051] In processing 802, the system of coordinates of a feature are computed based on the posture of the feature obtained in the tab-control-specification input from a user.
[0052] In processing 803, the relative position of the feature class inputted by the user, size, a parent feature, and the feature required in processing 801 and the system of coordinates of the feature required in processing 802 are registered to the feature model 142 through the feature model Management Department 134.
[0053] In processing 804, the feature performs the judgment of an outline configuration feature or a partial feature from a feature class.
[0054] When judged with an outline configuration feature, it progresses to processing 805, the outline configuration generation section 135 is started, and configuration generation processing of an outline configuration feature is performed. The configuration of the generated outline configuration feature is stored in the outline geometric model 143 through the outline configuration Management Department 136. About this processing 805, it mentions later using drawing 12 (a).
[0055] On the other hand, when judged with a partial feature by processing 804, it progresses to processing 806, the outline configuration generation section 135 is started, and configuration generation processing of the approximation outline configuration reflecting a partial configuration is performed. The configuration of the approximation outline configuration reflecting the generated partial configuration is stored in the outline geometric model 143 through the outline configuration Management Department 136. About this processing 806, it mentions later using drawing 12 (b). Furthermore, the partial feature model generation section 137 is started by processing 807, a partial feature model is generated, and registration to the partial feature model 144 is performed through the partial feature model Management Department 138.
[0056] The outline configuration generation section 135 performs processing about generation of the configuration of each feature.
[0057] As an approach of managing three-dimension configurations, such as a machine part, it is ""Geometric modelling, for example. : Various approaches are learned as indicated by a survey", A Baer, C Eastman and M Henrion, Computer-Aided Design, Vol.11, No.5, (1979), and pp.253-272."
[0058] Here, the management method of the configuration of the three dimension based on a general boundary representation method (B-Reps) is explained. A three-dimension configuration is expressed by five kinds of configuration elements, a solid element, a field element, a circumferential element, a ridgeline element, and a top-most-vertices element, and is managed.
[0059] For example, the boundary of the interior and the exterior of a solid element shown in drawing 9 (a) is expressed by one or more field elements as shown in drawing 9 (b). Furthermore, the boundary of the interior and the exterior of a field element is expressed by one or more circumferential elements as shown in drawing 9 (c). In this example, the boundaries of the field element 1 are the circumferential element 1 and the circumferential element 2, and the boundary of the field element 2 is the circumferential element 3.
[0060] The boundary of a circumferential element is expressed by one or more ridgeline elements as

shown in drawing 9 (d). In this example, the ridgeline element 1 and ridgeline element 2 grade are the boundaries of the circumferential element 1. The boundary of a ridgeline element is expressed by the top-most-vertices element as shown in drawing 9 (e). In this example, the boundaries of the ridgeline element 1 are the top-most-vertices element 1 and the top-most-vertices element 2, and the boundaries of the ridgeline element 2 are the top-most-vertices element 2 and the top-most-vertices element 3. In this example, the top-most-vertices element 2 is also the boundary of the ridgeline element 1, and is also the boundary of the ridgeline element 2. Moreover, the ridgeline element 1 is also the boundary of the circumferential element 1, and is also the boundary of the circumferential element 3.

[0061] Therefore, these solid elements, a field element, a circumferential element, a ridgeline element, and a top-most-vertices element are managed as a network as shown in drawing 10 based on each adjacency.

[0062] The outline configuration Management Department 136 manages the outline geometric model 143 according to DS like drawing 10 , and is expressing the configuration of components. The outline configuration generation section 135 generates a configuration element for change of the configuration by the actuation which the designer performed on DS like drawing 10 , deletes it, corrects the geometric data currently held for every configuration element, or corrects network connection relation, and makes it reflected using the outline configuration Management Department 136.

[0063] the configuration part corresponding to a partial feature on the basis of the approach of managing a configuration by using as a configuration element the solid element which is the above-mentioned approach, a field element, a circumferential element, a ridgeline element, and a top-most-vertices element at the outline geometric model 143 of this invention, and the outline configuration Management Department 136 -- approximation -- it omitted and expressed-like and has the description of managing as an outline configuration. That is, the ridgeline element of the outline geometric model 143 extended the ridgeline element of the conventional geometric model, and is equipped with the partial feature section flag with the ridgeline part identifiable whether it is the ridgeline which corresponded to the partial feature part and was expressed in approximation. The extract algorithm of a cost factor is simplified by having this description. About the processing algorithm of configuration generation or configuration correction, things can perform using the approach of the conventional configuration management.

[0064] The outline configuration which in the case of the components shown in drawing 2 was approximated as shown in drawing 11 (a) is stored in the outline geometric model 143. Moreover, the shape of an extensive form shown in the middle of drawing 3 is similarly approximated like drawing 11 (b) as an outline configuration. In drawing 11 , the thick wire showed the ridgeline which expressed the partial feature in approximation. namely, the configuration part corresponding to the notch for bolts and the burring hole for tapping screws which are the partial feature which appears in drawing 2 -- approximation -- it is omitted and expressed-like. Like the burring hole for tapping screws, in the case of the partial feature of a field addition mold, it is omitted and is expressed by the approximation ridgeline element by partial features other than a field addition mold like the notch for bolts which is the partial feature of an edge addition mold.

[0065] The procedure about configuration generation processing in the outline configuration generation section 135 is divided when related with the case where it is related with an outline configuration feature, and a partial feature, and it is shown in drawing 12 (a) and drawing 12 (b).

[0066] In configuration generation processing of an outline configuration feature, it progresses to processing 1201, and searches and asks for the configuration generation procedure after processing from the outline configuration feature library 146. Next, in processing 1202, based on the called-for configuration generation procedure after processing, configuration generation processing of an outline configuration feature is performed, the outline geometric model Management Department 135 is started, and it stores in the outline geometric model 143.

[0067] In configuration generation processing of a partial feature, it progresses to processing 1203 and the feature judges whether it is the feature of a field addition mold, it is the feature of an edge addition mold, or it is the feature of an angle addition mold based on a feature class. It seems that the feature of

an angle addition mold is shown in drawing 13 (c) as the feature of a field addition mold is shown in drawing 13 (a) and the feature of an edge addition mold is shown in drawing 13 (b).
[0068] Based on this judgment result, if it is an edge addition mold, and it is an angle addition mold, it will progress to processing 1204 at processing 1205, respectively. It does not process, especially when judged with it being the feature of a field addition mold. In processing 1204, the outline configuration generation section 135 is started and outline configuration processing for edge addition mold partial features is performed. In processing 1205, the outline configuration generation section 135 is started and outline configuration processing for angle addition mold partial features is performed.
[0069] Here, since the generation procedures of the data expressing the configuration in the outline geometric model 143 differ for every class of feature in the case of an outline configuration, a configuration generation procedure is prepared for every feature class, and it is stored all over the feature library.
[0070] On the other hand, in the case of a partial feature, the generation procedure of the data expressing the configuration in the outline geometric model 143 is two kinds, an edge addition mold and an angle addition mold, and even if the class of new feature is added, it does not change. For example, in the case of an edge addition mold, even if it is V notch shown in the drawing 13 (b) right-hand side even if the class of feature was the notch for bolts shown in the drawing 13 (b) left-hand side, it is expressed by the same procedure so that it may be the thick wire part of drawing 11 .
[0071] The partial feature generation section 137 manages the partial feature model 144 using the partial feature Management Department 138, and performs processing called the generation of data, reference, and updating which are stored in the partial feature model 144.
[0072] The data stored in the partial feature model 144 are data about the partial feature contained in the components which the user inputted, and express the abbreviation or the part currently expressed in approximation in the outline geometric model 143.
[0073] The contents of the partial feature model 144 are shown in drawing 14 by making into an example the case of the components shown in drawing 2 . Each partial feature is expressed by the data item of "Feature ID", a "location", and a "posture." "Feature ID" shows the feature to which it corresponds in the feature model 142. A "location" expresses the location of a feature with the coordinate value on the absolute coordinate system of a three dimension. A "posture" expresses the posture of a feature by two direction vectors with which it intersects perpendicularly on the absolute coordinate system of a three dimension.
[0074] The procedure of partial feature registration processing in the partial feature generation section 137 is shown in drawing 15 . In processing 1501, the location and posture of a feature on the absolute coordinate system of three-dimension space are searched for. A location is called for using the relative position of 142 in a feature model, and the system of coordinates of a parent feature. A posture is searched for using the posture in the feature model 142, and the system of coordinates of a parent feature. In processing 1502, registration to the partial feature model 144 is performed using the partial feature Management Department 138.
[0075] The display-processing section 132 displays the configuration of the components which the user inputted on a display 120. The procedure in the display-processing section 132 is shown in drawing 16 .
[0076] In processing 1601, the geometric data of the ridgeline of an outline configuration feature part are taken out from the outline geometric model 143. This distinguishes the ridgeline element which expressed the configuration part corresponding to a partial feature in approximation from the outline geometric model 143 using a partial feature section flag, and is performed by taking out the geometric information about all the ridgeline elements except the ridgeline element which approximated the configuration part corresponding to a partial feature.
[0077] In processing 1602, a partial feature is taken out sequentially from the partial feature model 144. Here, if processing 1603 - processing 1605 have already been performed to all partial features, it will progress to processing 1606. If the partial feature to which processing 1603 - processing 1605 are not performed is taken out, it will progress to processing 1603.
[0078] In processing 1603, it asks for the class and size of a partial feature which were chosen as a

processing object by processing 1602 using the data of the feature ID in the partial feature model 144, and the data of the feature class in the feature model 142, and the geometric data of the class of partial feature and the ridgeline element currently beforehand prepared for every size are taken out out of the partial feature library 147.

[0079] In processing 1604, coordinate transformation is performed to the geometric data of the ridgeline element of a partial feature taken out by processing 1603 using the location data and posture data in the partial feature model 144.

[0080] In processing 1605, the geometric data of the ridgeline element of the partial feature by which coordinate transformation was carried out by processing 1604 are compounded to the geometric data of the ridgeline element of the configuration part corresponding to the outline configuration feature obtained by processing 1601.

[0081] After processing 1605 is completed, it returns to processing 1602 and the following processing object is chosen. After processing 1603 - processing 1605 are performed to all the partial features contained in the components which the user inputted, it progresses to processing 1606. In processing 1606, coordinate transformation according to an eye direction is performed to the geometric data of the ridgeline element obtained by processing 1601 - processing 1605.

[0082] In processing 1607, the configuration of the components which the user inputted into the display 120 using the geometric data of the ridgeline element by which coordinate transformation was carried out by processing 1606 is displayed.

[0083] Based on the CAD data 141 of the components which the user inputted, the cost factor generation section 139 asks for the cost factor which is required information, when computing the cost of the component.

[0084] The outline of the procedure in the cost factor generation section 139 is shown in drawing 17 .

[0085] In processing 1701, the outline geometric model 143 and the partial feature model 144 about the shape of an extensive form of components are generated from the feature model 142.

[0086] In processing 1702, it asks for a cost factor from the partial feature model 144 about the shape of an extensive form of the components generated by processing 1701. The cost factor required in processing 1702 is data about the punching processing part which used NC turret punch press equipment. Since a punching processing part is processed by specific punch metal mold, the class and the count of punch of punch metal mold serve as a cost factor. Since the punching processing part contained in the components which the user inputted is specified by the partial feature model 144 and correspondence with the class of partial feature and size is beforehand registered into the partial feature library 147, the class and the count of punch of punch metal mold are called for easily. In the case of the components of drawing 2 , into the partial feature model 144, the notch for bolts and every one burring hole for tapping screws are registered. as shown in drawing 4 , the notch part for bolts is processed with the punch metal mold a bolthole and for notches -- having -- a part for the burring hole for tapping screws -- the prepared hole of the punch metal mold for tapping screw holes -- public funds -- a mold and burring -- public funds -- it turns out that being processed with a mold is registered all over the partial feature library 147, and three kinds of such punch metal mold is used by a unit of 1 time, respectively. Naturally, such correspondence of a partial feature and punch metal mold is registered for every size of a partial feature.

[0087] In processing 1703, it asks for a cost factor from the outline geometric model 143 about the shape of an extensive form of the components generated by processing 1701. The cost factors required in processing 1703 are the data about a stock size, data about the nibbling processing part using NC turret punch press equipment, etc. The data about a stock size are the area of a material, die length, width of face, the value of board thickness, etc., and are obtained by asking for the minimum rectangular parallelepiped which carries out the epicyst of the shape of an extensive form of components simply. Furthermore, it can also ask for the data about a stock size more correctly by comparing the dimension of the minimum rectangular parallelepiped which carries out epicyst to the data about the dimension of the purchased material. Moreover, about board thickness, it is obtained from the feature model 142 also by the approach of searching for directly.

[0088] In order to process it about the nibbling processing part using general-purpose punch metal mold, such as a square shape, one side of the punch metal mold used for processing with processing profile length can be asked for the count of punch from die length, and this serves as a cost factor. Selection of the punch metal mold used for processing and calculation of processing profile length are performed based on the ridgeline element which constitutes a profile configuration.
[0089] Here, the example at the time of using the outline geometric model 143 and the partial feature model 144 which are the description of this invention at drawing 18 (a) and (c) about the example at the time of using the conventional geometric model which is distinguishing and expressing the punching processing part and the nibbling processing part is shown in drawing 18 (c) and (d).
[0090] Here, like drawing 18 (a), when the conventional geometric model was used, since the punching processing part and the nibbling processing part were not distinguished and were expressed, there was a trouble of selecting small punch metal mold superfluously, in response to the effect of a punching processing part. For example, in the case of drawing 18 (a), if square shape punch metal mold with long die length of one side is used from a dimension B, it will be judged [ that it is not processible and ], and punch will be assigned like drawing 18 (c). However, in fact, since the part of the notch for bolts is processed using a bolthole and the punch metal mold for notches as shown in drawing 4 R> 4 (a), die length of one side can process it by square shape punch of A like drawing 18 (d).
[0091] Moreover, there was a trouble of being computed otherwise by the die length in which profile length contained the punching part. With the design exchange equipment 100 of this invention, selection of punch metal mold and calculation of profile length can be correctly performed by the simple approach by using the outline geometric model 143 and the partial feature model 144. The punch metal mold quota approach of NC turret punch press equipment of above-mentioned this invention is available also as automatic-programming generation equipment of NC turret punch press equipment.
[0092] In processing 1704, the outline geometric model 143 and the partial feature model 144 about the configuration after processing of components are generated.
[0093] In processing 1705, it asks for a cost factor from the outline geometric model 143 about the configuration after processing of the components generated by processing 1704. The cost factor required in processing 1705 is data about bending and press working of sheet metal. For example, there are a count of bending, the direction of each bending, the die length of an angle of bend and a bending line, etc. in the cost factor about bending. Moreover, there are the direction of [ for a converging section / the number and each burring part for a converging section, such as a burring part, etc. ], the depth, profile length, etc. in the cost factor about press working of sheet metal.
[0094] In asking from the geometric model which distinguished and expressed a partial configuration part and other configuration parts like before by using the outline geometric model 143 also when asking for these data Although there was a problem that an algorithm became complicated in order to incorrect-recognize the burring hole for tapping screws, and the local processing part carry out louvering and according to punching processing like a configuration to be a press-working-of-sheet-metal part and a bending part, respectively or to prevent incorrect recognition These problems are solvable.
[0095] For example, by carrying out louvering, in the case of a configuration, the size is comparatively small, and a thing like drawing 19 (a) by which size is standardized can be processed using NC turret punch press, and if such punch metal mold corresponding to [ carry out louvering and ] a configuration part is prepared, it can create by punching processing. In such a case, it sets, and if the conventional geometric model which distinguishes and expresses a partial configuration part and other configuration parts is used, punch metal mold will be assigned to a part like drawing 19 (b) in the shape of an extensive form as nibbling processing, and a misjudgment law will be carried out to 1 more time of a bending process or a press process being required.
[0096] In this invention, if such punch metal mold corresponding to [ carry out louvering and ] a configuration part is prepared, since it registers with the partial feature library 147 as a partial feature of a field addition mold, a cost factor is outputted correctly. Since it cannot choose from the menus displayed on a designer reflecting the class and size of a feature which are not registered into the partial feature library 147, but are registered into the partial feature library 147 when it is the size for which

punch metal mold is not prepared, a designer will input using the rectangle hole and rectangle addition plate which are an outline configuration feature. in this case -- this -- louvering is carried out, and a configuration part is also expressed on the outline geometric model 143, assigns punch metal mold as nibbling processing, and is correctly judged as one more bending or press working of sheet metal being required.

[0097] The procedure in the generation procedure of the outline geometric model 143 which is components data about the generation procedure of the outline geometric model 143 which is components data about the shape of an extensive form started by processing 1701, and the partial feature model 144, and the configuration after processing started by processing 1704, and the partial feature model 144 is shown in drawing 20 .

[0098] In processing 2001, the feature by which the feature of the class of the rectangle orientation plate with which a parent feature does not exist, or indeterminate form orientation plate, or the parent feature is already processed is chosen from the feature model 142 as a processing object.

[0099] Processing is ended when all the features in the feature model 142 are processed. In processing 2002, processing of the processing 802 of drawing 8 - processing 807 performs the re-calculation and updating of data which are related to the feature chosen as a processing object by processing 2001. However, in processing 803, a feature is not registered but the data about a processing-object feature are updated. Moreover, in generation processing of the components data about the shape of an extensive form, processing of processing 1201 becomes in the procedure started by processing 805 not with retrieval of the configuration generation procedure after processing but with retrieval of an extensive form-like generation procedure. That is, both the configuration generation procedure after processing and the extensive form-like generation procedure are described by the outline configuration feature library 146, and, not only the case of the components processed by linear bending by this but in the case of the components with a part for the burring part of components as shown in drawing 2 , and a converging section processed by press working of sheet metal, extensive form-like components data can be generated.

[0100] Here, the after [ processing ] configuration generation procedure of the burring part of components as shown in drawing 2 , and an extensive form-like generation procedure are taken for an example, and it is shown in drawing 21 and drawing 22 .

[0101] In processing 2101, it asks for the ridgeline element group to which a burring feature is added out of the outline geometric model 143. That is, it asks for the ridgeline part of drawing 22 (b) out of the outline geometric model 143 showing the configuration shown in drawing 22 (a).

[0102] Next, in generating the configuration after processing, it attaches the thickness for board thickness by processing 2102 on the flat surface where it belongs a ridgeline element group. Thereby, a two-dimensional configuration like drawing 22 (c) is acquired.

[0103] Next, by processing 2103, the sweep of the two-dimensional configuration of drawing 22 (c) is carried out in the height specified in the direction of a normal of the flat surface where a ridgeline element group belongs, and a solid configuration like drawing 22 (d) is generated.

[0104] On the other hand, in generating the shape of an extensive form, by processing 2104, the sweep of the ridgeline element group is carried out in the height specified in the direction of an outside of the flat surface where it belongs, and it generates the two-dimensional configuration of drawing 22 (f).

[0105] Next, by processing 2105, the thickness for board thickness is attached to the two-dimensional configuration of drawing 22 (f), and a solid configuration like drawing 22 (g) is generated.

[0106] In processing 2106, the solid configuration generated by processing 2103 or processing 2105 is compounded with the original solid configuration, and the solid configuration which added the burring part like drawing 22 (e) and drawing 22 (h) is generated.

[0107] Such a configuration generation procedure after processing and an extensive form-like generation procedure are stored in the outline configuration feature library 146 for every outline configuration feature. Thus, by having the configuration generation procedure after processing, and extensive form-like generation procedure, an after [ processing ] geometric model and an extensive form-like model are automatically generable from the feature model 142 also in the configuration including burring, a

diaphragm, etc. which was not able to respond by the method which performs conversion with the shape of the configuration after processing, and an extensive form more for performing system-of-coordinates conversion.

[0108] The cost estimated section 1310 estimates cost at the cost factor called for by the cost factor generation section 139 from the criteria cost data 148. Although various approaches can be considered in the approach of a cost estimate, it asks by adding the criteria cost value simply set up for every cost factor.

[0109] For example, if data, such as material criteria cost data as shown in drawing 23 R> 3 (a), expansion working standard cost data as shown in drawing 23 (b), and bending working standard cost data as shown at drawing 23 (c), are stored in the criteria cost data 148, it can ask for the cost of components by asking for the cost to each cost factor, and adding them. As material criteria cost data, as shown in drawing 23 (a), the cost per unit area corresponding to the class of board thickness and the class of board thickness is stored, respectively. As expansion working standard cost data, as shown in drawing 2323 (b), the cost per count of punch corresponding to the number of classes of punch metal mold and the number of classes of punch metal mold is stored, respectively. As bending working standard cost data, the die length of a bending line, an angle of bend, and the cost per [ corresponding ] bending are stored in drawing 23 (c) so that it may be shown. The estimated cost value is displayed on a display 120 by the display-processing section 132.

[0110] Generally, the cost estimate of a product or a sub-assembly article is performed using a bill of material report as shown in drawing 24 . The example of drawing 2424 shows that a product 1 consists of a sub-assembly article 1, a sub-assembly article 2, and components 6, the sub-assembly article 1 consists of components 1 and components 2, and the sub-assembly article 2 consists of components 3, components 4, and components 5. Here, the cost of a product 1 is called for as the sum total of the cost which the cost of the sub-assembly article 1, the cost of the sub-assembly article 2, the costs of components 6, and those assembly take. Furthermore, the cost of the sub-assembly article 1 serves as the sum total of the cost which the cost of components 1, the costs of components 2, and those assembly take. Although the cost of each component must be called for by a certain approach, the approach of this invention can be used to sheet-metal components here.

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[Translation done.]

* NOTICES *



1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the configuration of the design exchange equipment which is one example of this invention.
[Drawing 2] It is the explanatory view showing an example of the components inputted into the design exchange equipment which is one example of this invention.
[Drawing 3] It is the explanatory view showing the processing approach of the sheet-metal components inputted into the design exchange equipment which is one example of this invention.
[Drawing 4] It is the explanatory view showing the expansion processing approach of the sheet-metal components inputted into the design exchange equipment which is one example of this invention.
[Drawing 5] It is the explanatory view showing an example of the alter operation of the design exchange equipment which is one example of this invention.
[Drawing 6] It is the flow chart which shows the procedure of the input-process section of the design exchange equipment which is one example of this invention.
[Drawing 7] It is an explanatory view explaining the DS of the feature model of the design exchange equipment which is one example of this invention.
[Drawing 8] It is the flow chart which shows the procedure of the feature generation section of the design exchange equipment which is one example of this invention.
[Drawing 9] It is an explanatory view explaining the boundary representation method which is an approach expressing a general three-dimension configuration.
[Drawing 10] It is an explanatory view explaining the DS of the boundary representation method which is an approach expressing a general three-dimension configuration.
[Drawing 11] It is an explanatory view explaining the configuration expression of the outline geometric model of the design exchange equipment which is one example of this invention.
[Drawing 12] It is the flow chart which shows the configuration generation procedure of the outline configuration generation section of the design exchange equipment which is one example of this invention.
[Drawing 13] It is the explanatory view showing the class of partial feature of the design exchange equipment which is one example of this invention.
[Drawing 14] It is an explanatory view explaining the DS of the partial feature model of the design exchange equipment which is one example of this invention.
[Drawing 15] It is the flow chart which shows the procedure of the partial feature model Management Department of the design exchange equipment which is one example of this invention.
[Drawing 16] It is the flow chart which shows the procedure of the display process section of the design exchange equipment which is one example of this invention.
[Drawing 17] It is the flow chart which shows the procedure of the cost factor generation section of the design exchange equipment which is one example of this invention.
[Drawing 18] It is the explanatory view showing an approach to assign the punch metal mold of NC turret punch press equipment.

[Drawing 19] With conventional design exchange equipment, extracting a cost factor correctly is the explanatory view showing the example of a difficult configuration.
[Drawing 20] It is the flow chart which shows the procedure which generates the components data of the shape of an extensive form of the design exchange equipment which is one example of this invention, and the components data of the configuration after processing.
[Drawing 21] It is the flow chart which shows an example of the outline configuration generation procedure stored in the outline configuration feature library of the design exchange equipment which is one example of this invention for every feature.
[Drawing 22] It is the explanatory view showing change of a configuration with an example of the outline configuration generation procedure stored in the outline configuration feature library of the design exchange equipment which is one example of this invention for every feature.
[Drawing 23] It is the explanatory view showing the criteria cost data of the design exchange equipment which is one example of this invention.
[Drawing 24] It is the explanatory view showing the bill of material report used for the cost estimate of a product or a sub-assembly article.
[Description of Notations]
100 Design Exchange Equipment
110 Input Unit
120 Display
130 Processing Unit
140 Data Storage
131 Input-Process Section
132 Display-Processing Section
133 Feature Generation Section
134 Feature Management Department
135 Outline Configuration Generation Section
136 Outline Configuration Management Department
137 Partial Feature Generation Section
138 Partial Feature Management Department
139 Cost Factor Generation Section
1310 Cost Estimated Section
141 CAD Data
142 Feature Model
143 Outline Geometric Model
144 Partial Feature Model
145 Feature Library
146 Outline Configuration Feature Library
147 Partial Feature Library
148 Criteria Cost Data

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[Translation done.]

* NOTICES *

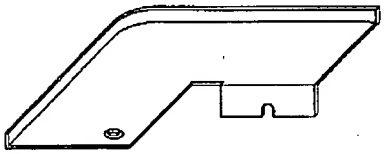


1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 2]

図2



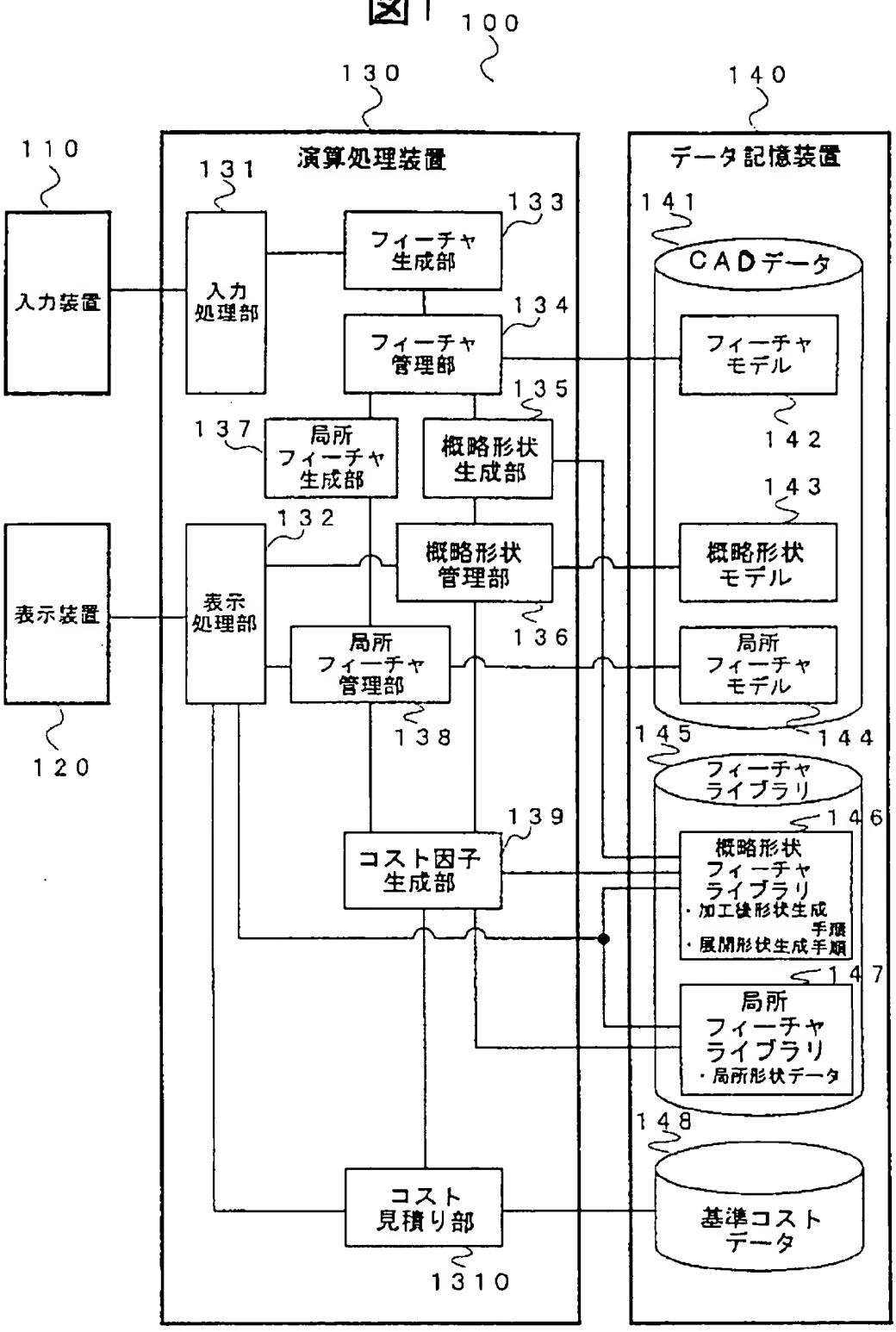
[Drawing 14]

図14

| | フィーチャＩＤ | 位置 | 姿勢 |
|---|---|---|---|
| 局所フィーチャ１ | フィーチャ６ | 座標値１ (Px, Py, Pz) | ｘ基準方向ベクトル１ (Vxx, Vxy, Vxz) ｙ基準方向ベクトル１ (Vyx, Vyy, Vyz) |
| 局所フィーチャ２ | フィーチャ７ | 座標値２ (Px, Py, Pz) | ｘ基準方向ベクトル２ (Vxx, Vxy, Vxz) ｙ基準方向ベクトル２ (Vyx, Vyy, Vyz) |
| : | : | : | : |

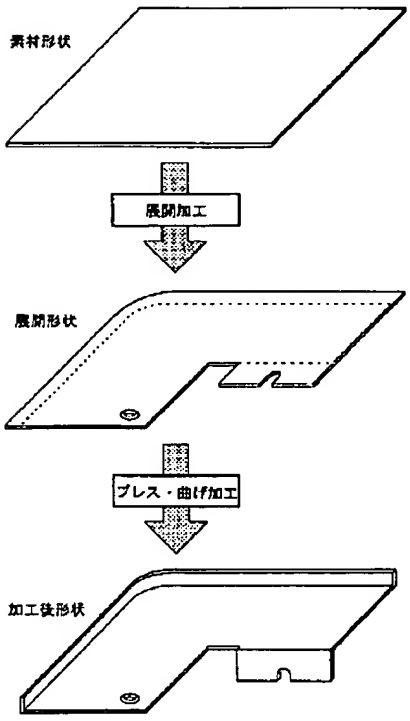
[Drawing 1]

図1


100
130
140
110
131
演算処理装置
データ記憶装置
133
141
入力装置
入力処理部
フィーチャ生成部
CADデータ
134
フィーチャ管理部
フィーチャモデル
135
137
局所フィーチャ生成部
概略形状生成部
142
143
132
概略形状管理部
概略形状モデル
表示装置
表示処理部
局所フィーチャ管理部
136
局所フィーチャモデル
138
145
144
フィーチャライブラリ
120
139
146
コスト因子生成部
概略形状フィーチャライブラリ
・加工後形状生成手順
・展開形状生成手順
147
局所フィーチャライブラリ
・局所形状データ
148
コスト見積り部
基準コストデータ
1310

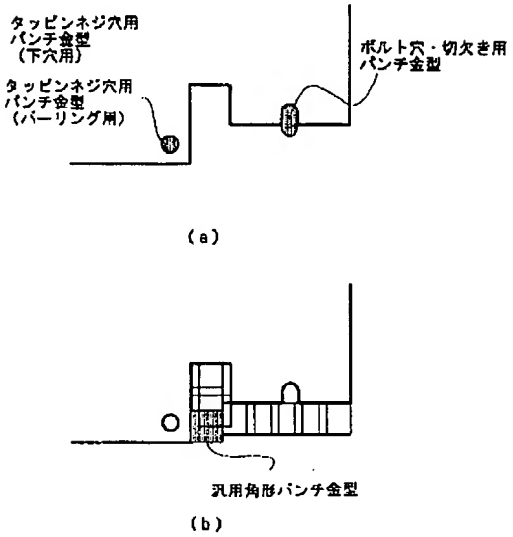
[Drawing 3]

図3



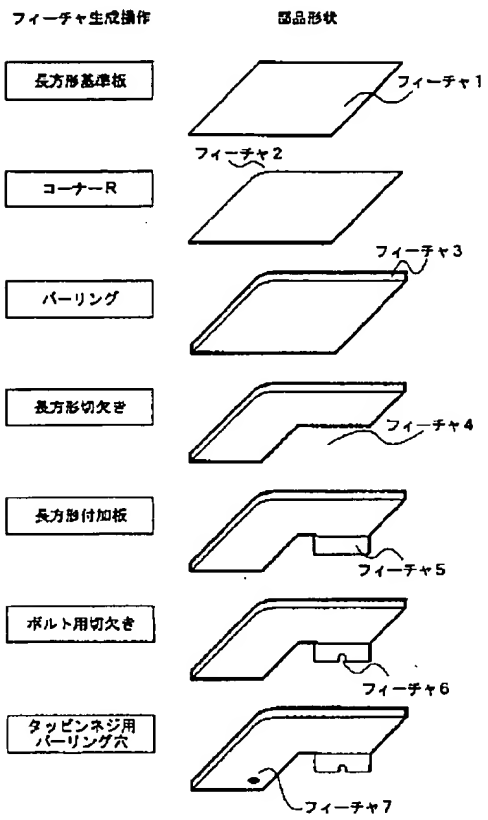

[Drawing 4]

図4



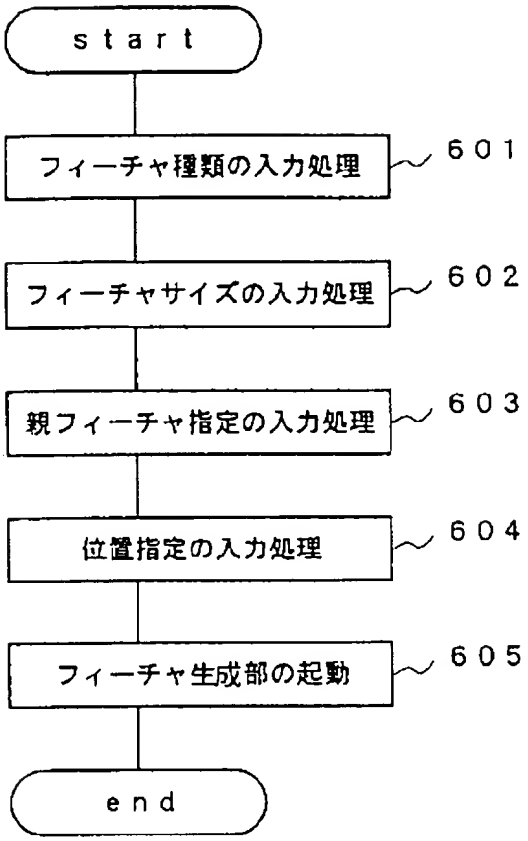

[Drawing 5]

図5


フィーチャ生成操作
部品形状
長方形基準板
コーナーR
バーリング
長方形切欠き
長方形付加板
ボルト用切欠き
タッピンネジ用
バーリング穴
フィーチャ1
フィーチャ2
フィーチャ3
フィーチャ4
フィーチャ5
フィーチャ6
フィーチャ7

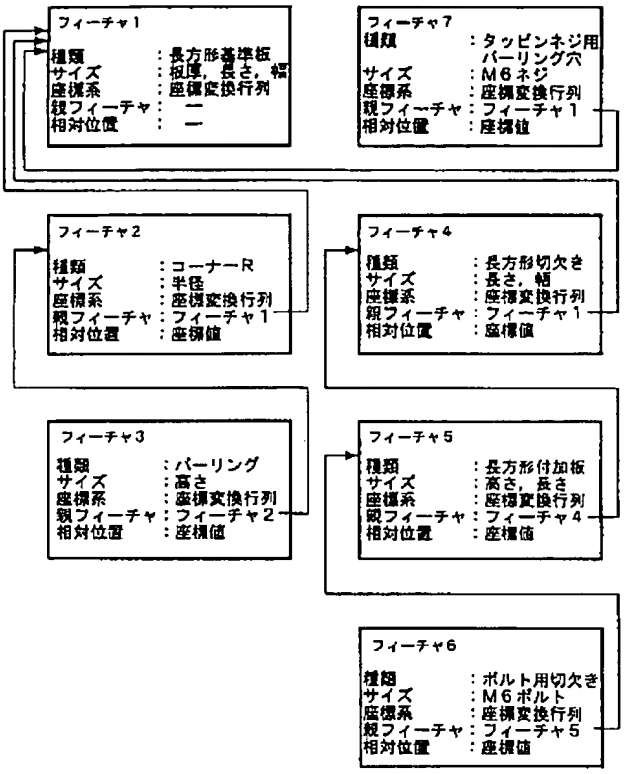
[Drawing 6]

図6


start
フィーチャ種類の入力処理
601
フィーチャサイズの入力処理
602
親フィーチャ指定の入力処理
603
位置指定の入力処理
604
フィーチャ生成部の起動
605
end

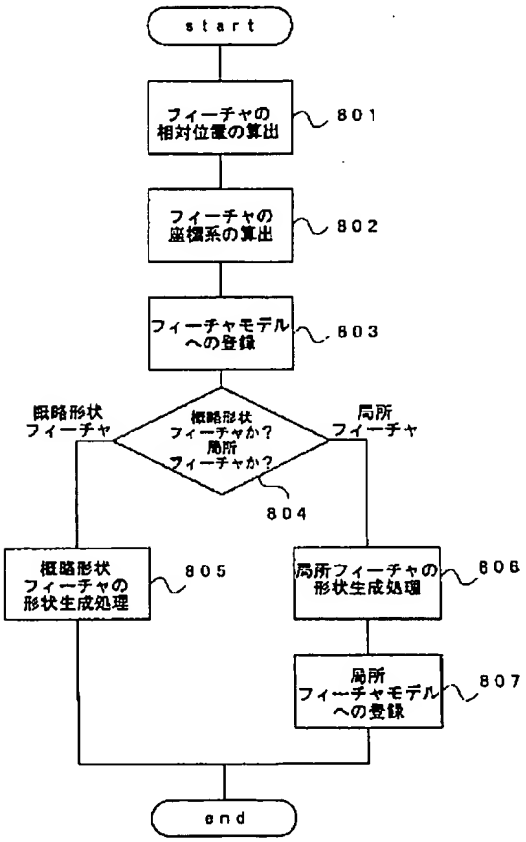
[Drawing 7]

図7



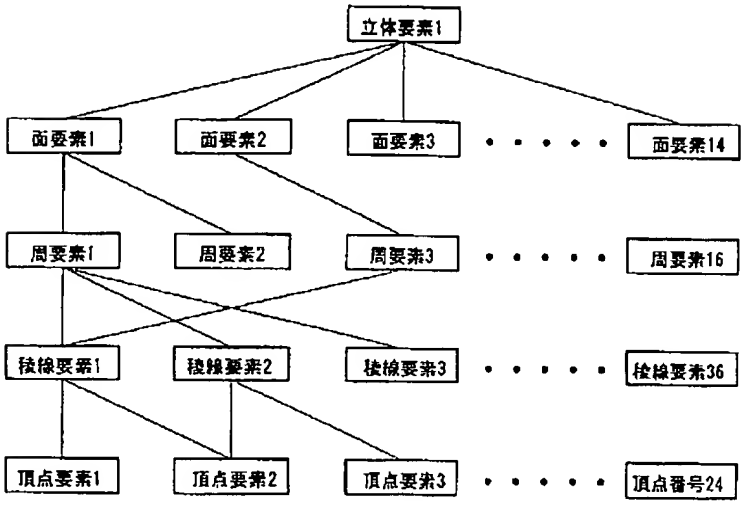

[Drawing 8]

図8



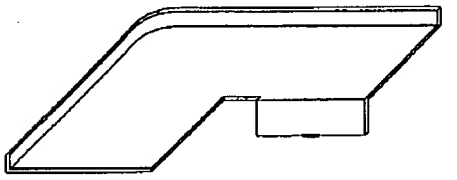
[Drawing 10]

図10

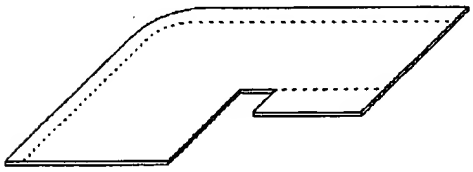



[Drawing 11]

図11



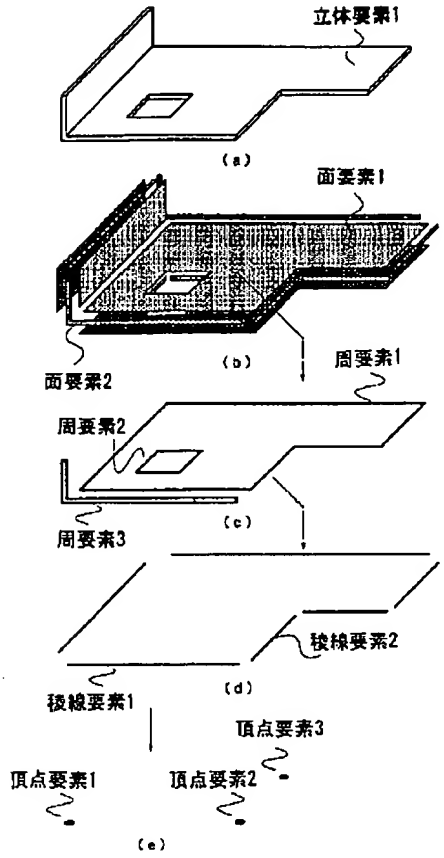
(a)



(b)

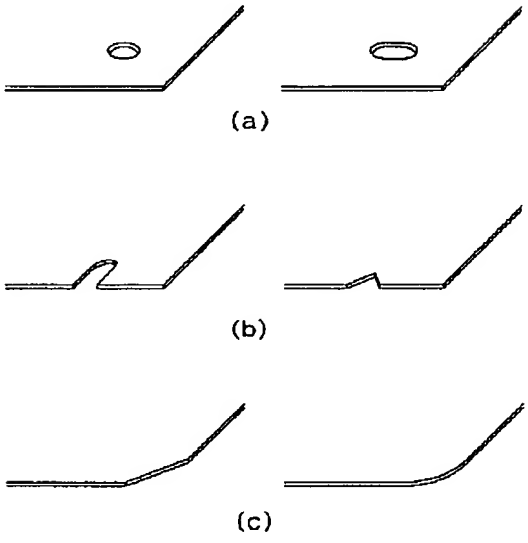
[Drawing 9]

図9



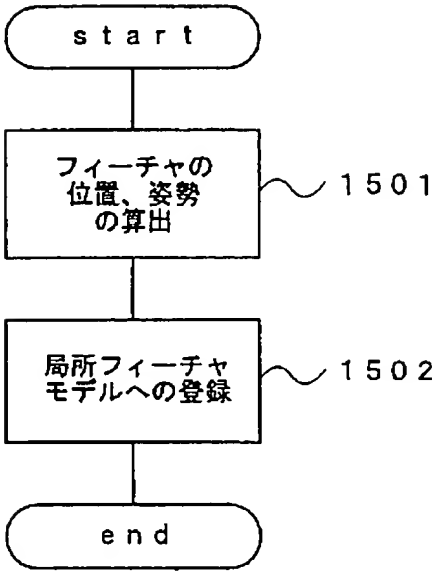

[Drawing 13]

図13

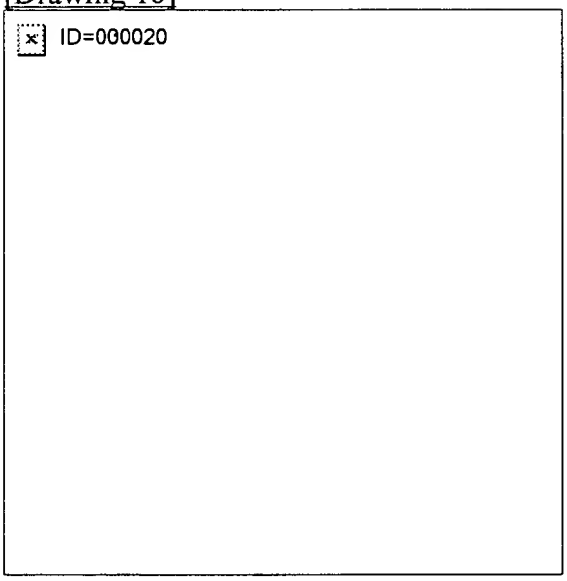



[Drawing 15]

図15

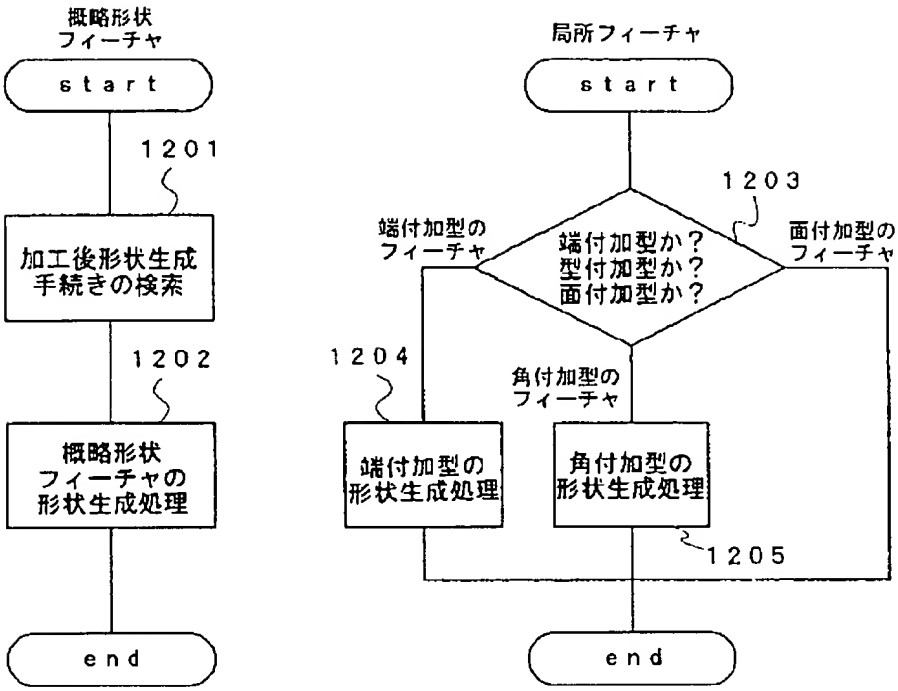



[Drawing 18]



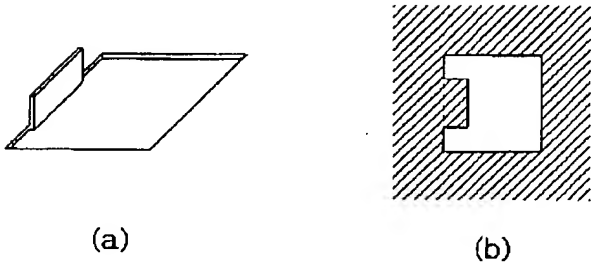

[Drawing 12]

図12



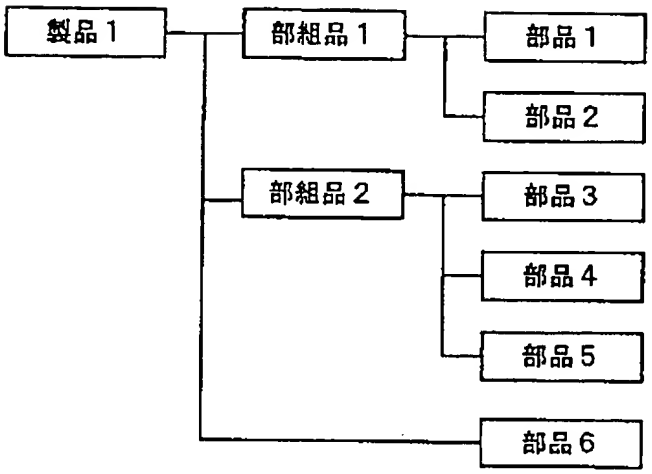

[Drawing 19]

図19



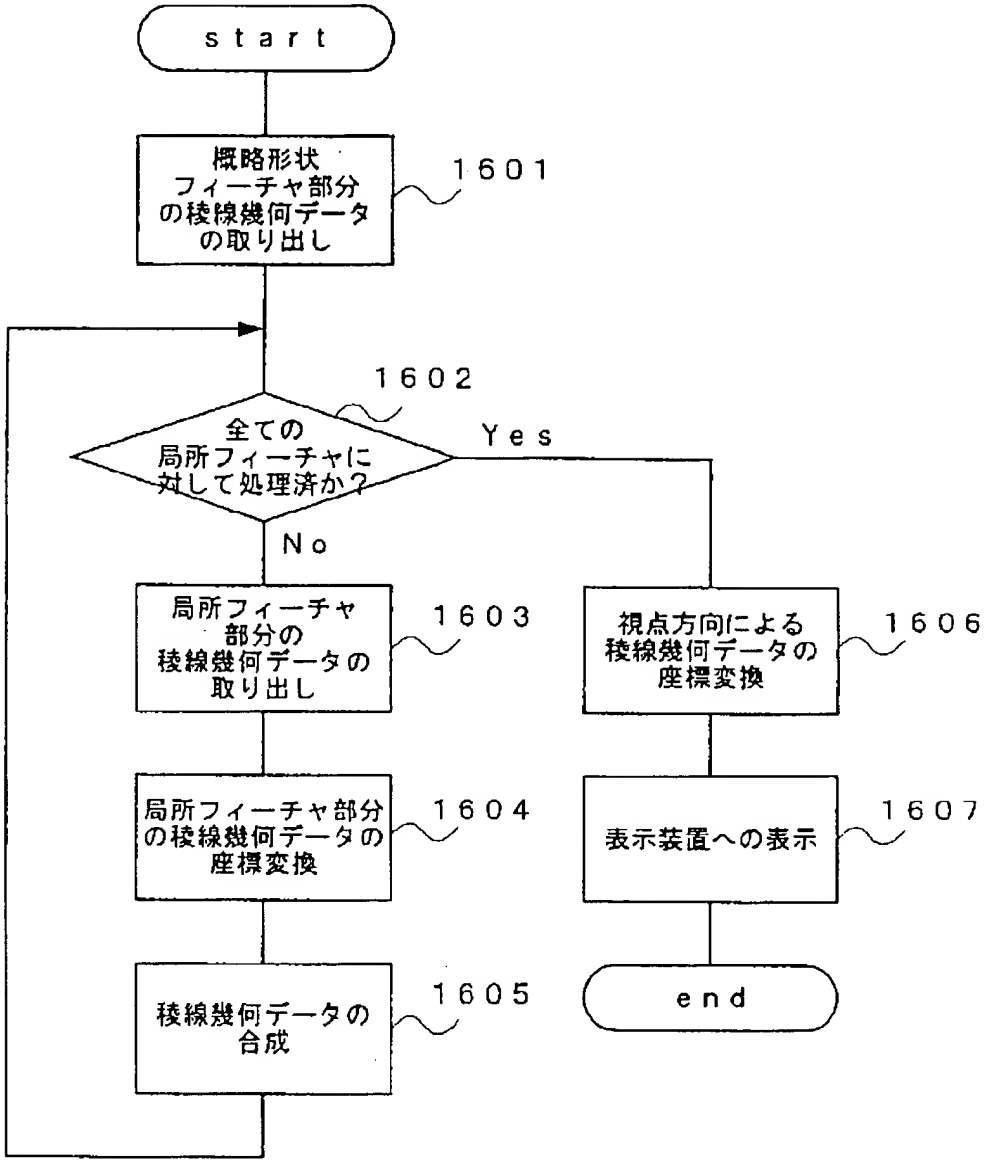

[Drawing 24]

図24



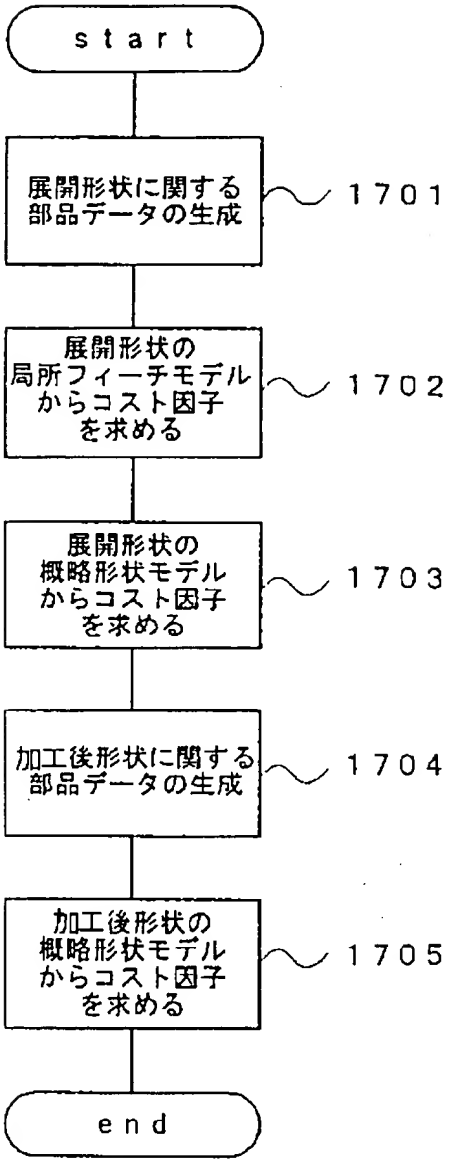

[Drawing 16]

図16



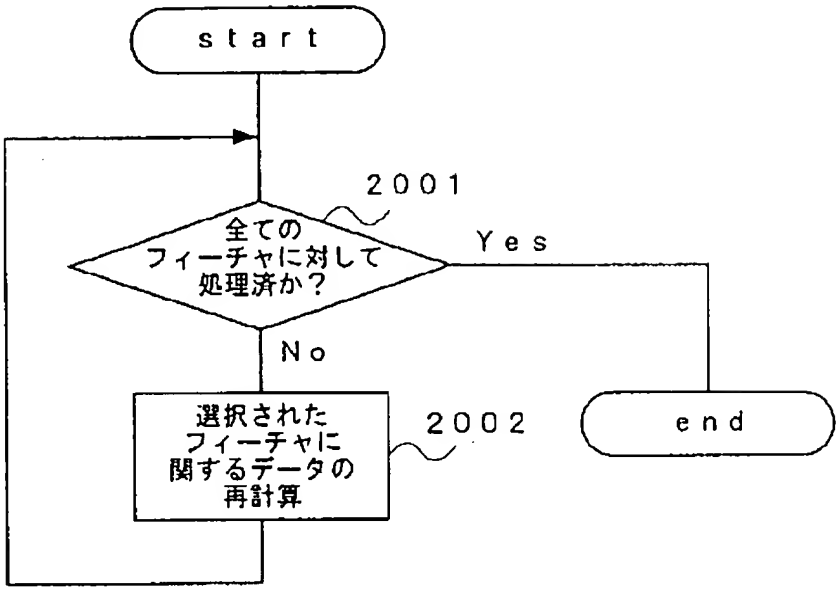

[Drawing 17]

図17



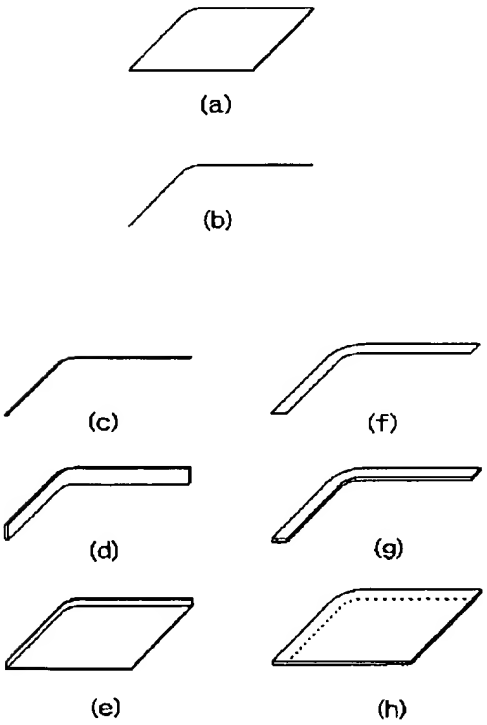

[Drawing 20]

図20



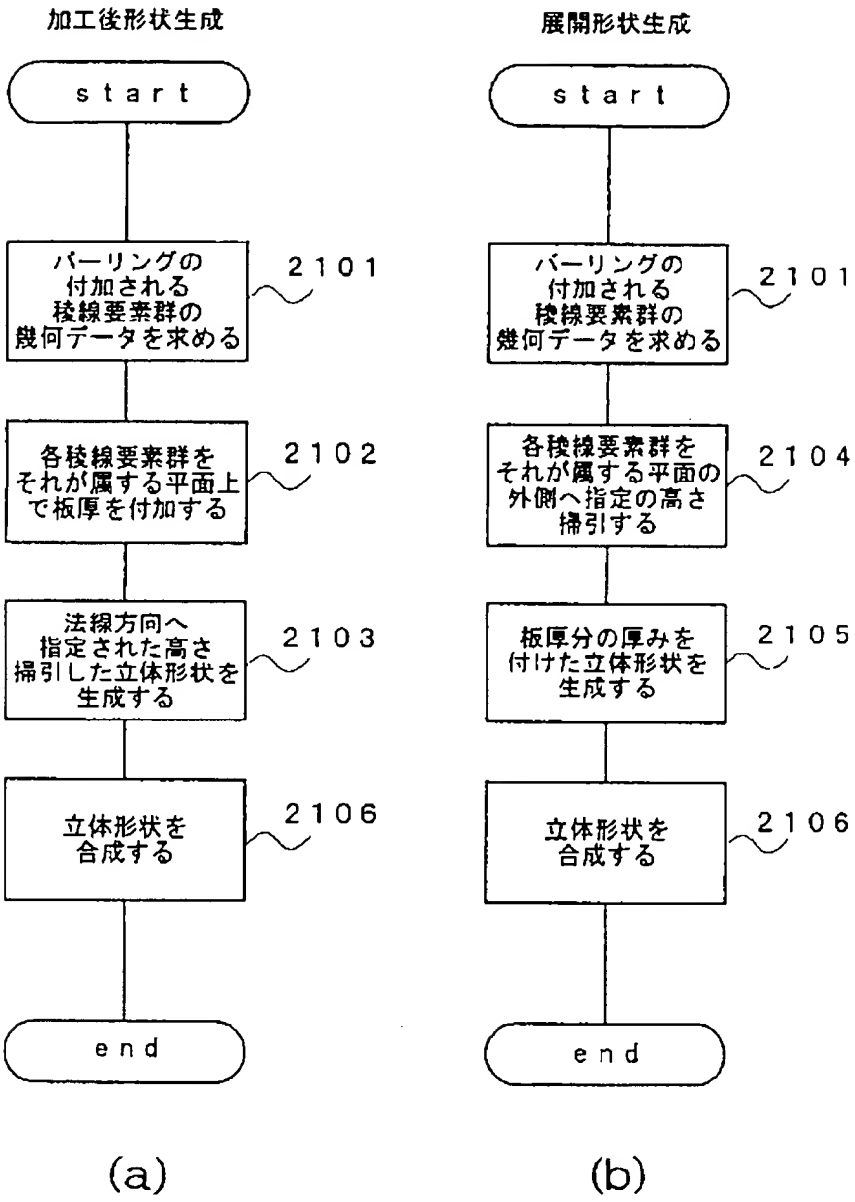

[Drawing 22]

図22




[Drawing 21]

図21




[Drawing 23]

図23

(a)

素材基準コストデータ

| 板厚(mm) | 単位面積当たりのコスト(¥/m²) |
|---|---|
| 0.8 | 100.0 |
| 1.0 | 120.0 |
| 1.2 | 130.0 |

(b)

展開加工基準コストデータ

| パンチ金型の種類数（種類） | パンチ回数当たりのコスト（¥/回） |
|---|---|
| n ≦20 | 2.0 |
| 20＜n ≦30 | 4.0 |
| 30＜n ≦40 | 7.0 |
| 40＜n | 10.0 |

(c)

曲げ加工基準コストデータ

| 曲げ線の長さ(mm) | 曲げ角度（°） | 曲げ当たりのコスト（¥/回） |
|---|---|---|
| L ≦60 | θ ≦90.0 | 25.0 |
| | 90.0＜θ | 60.0 |
| 60＜L | θ ≦90.0 | 35.0 |
| | 90.0＜θ | 80.0 |

[Translation done.]

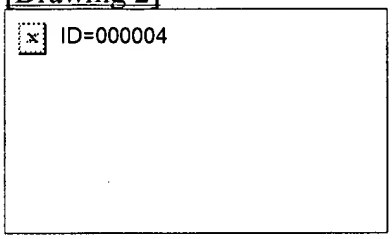
* NOTICES *



1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 2]



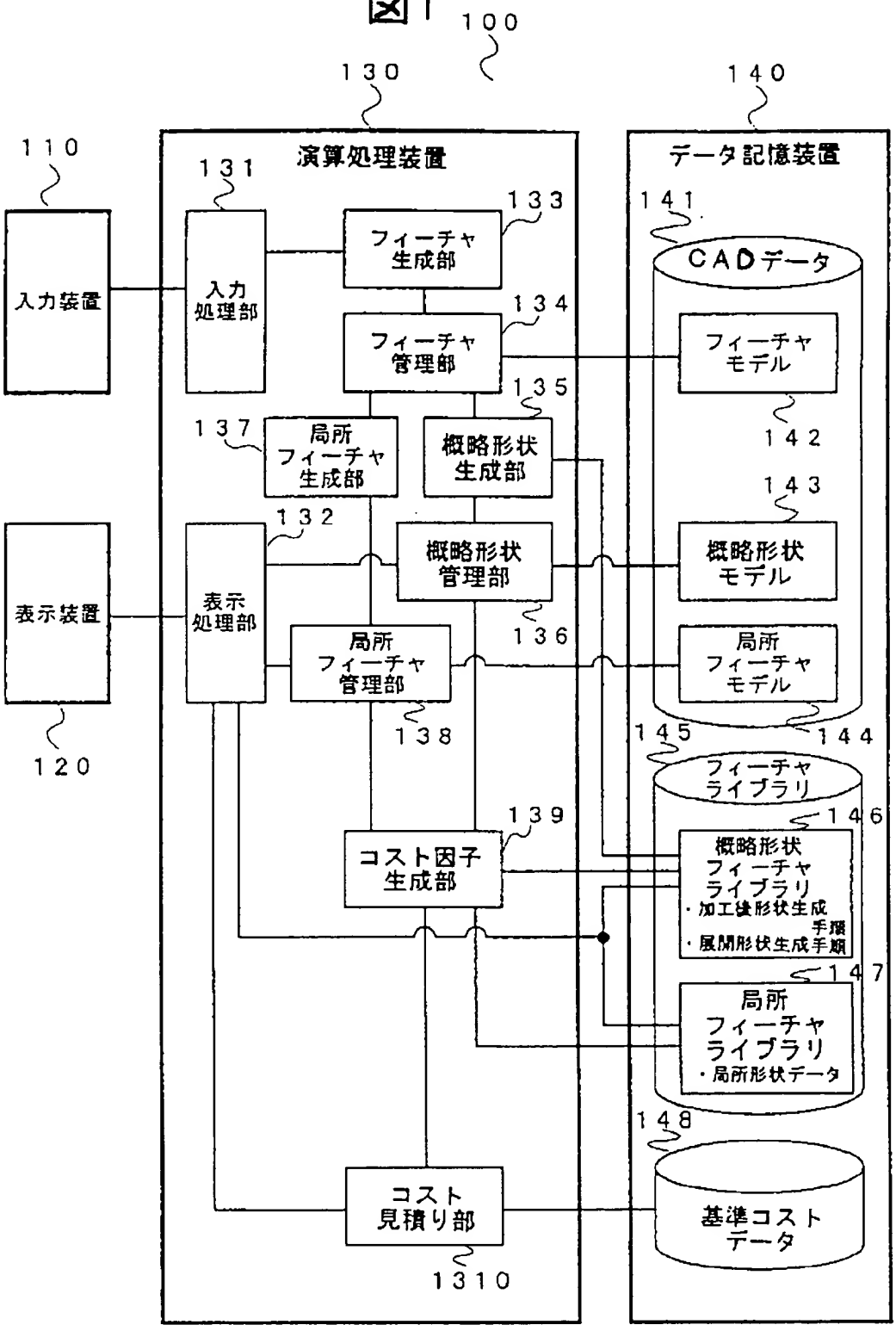

[Drawing 14]

図14

| | フィーチャＩＤ | 位置 | 姿勢 |
|---|---|---|---|
| 局所フィーチャ１ | フィーチャ６ | 座標値１ (Px, Py, Pz) | x基準方向ベクトル１ (Vxx, Vxy, Vxz) y基準方向ベクトル１ (Vyx, Vyy, Vyz) |
| 局所フィーチャ２ | フィーチャ７ | 座標値２ (Px, Py, Pz) | x基準方向ベクトル２ (Vxx, Vxy, Vxz) y基準方向ベクトル２ (Vyx, Vyy, Vyz) |
| : | : | : | : |

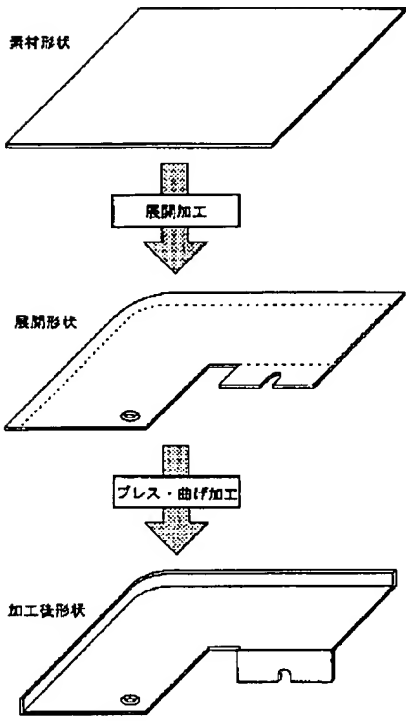
[Drawing 1]

図1


100
130
140
110
演算処理装置
データ記憶装置
131
133
141
入力装置
入力処理部
フィーチャ生成部
CADデータ
134
フィーチャ管理部
フィーチャモデル
135
137
142
局所フィーチャ生成部
概略形状生成部
143
132
概略形状管理部
概略形状モデル
表示装置
表示処理部
136
局所フィーチャ管理部
局所フィーチャモデル
138
145
144
120
フィーチャライブラリ
139
146
コスト因子生成部
概略形状フィーチャライブラリ
・加工後形状生成手順
・展開形状生成手順
147
局所フィーチャライブラリ
・局所形状データ
148
コスト見積り部
基準コストデータ
1310

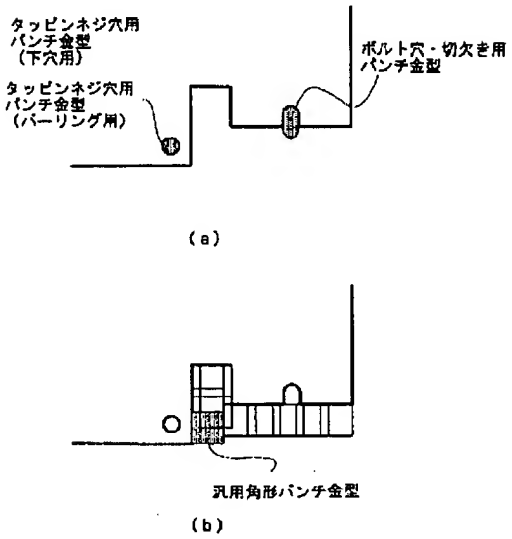
[Drawing 3]

図3



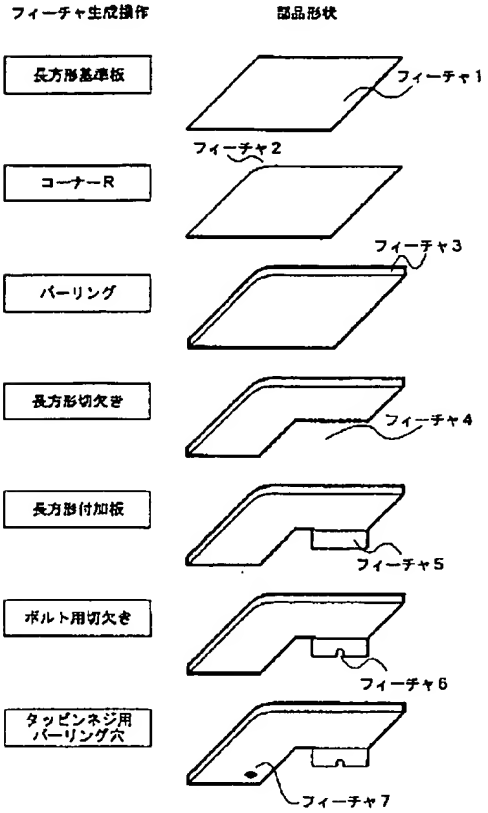

[Drawing 4]

図4



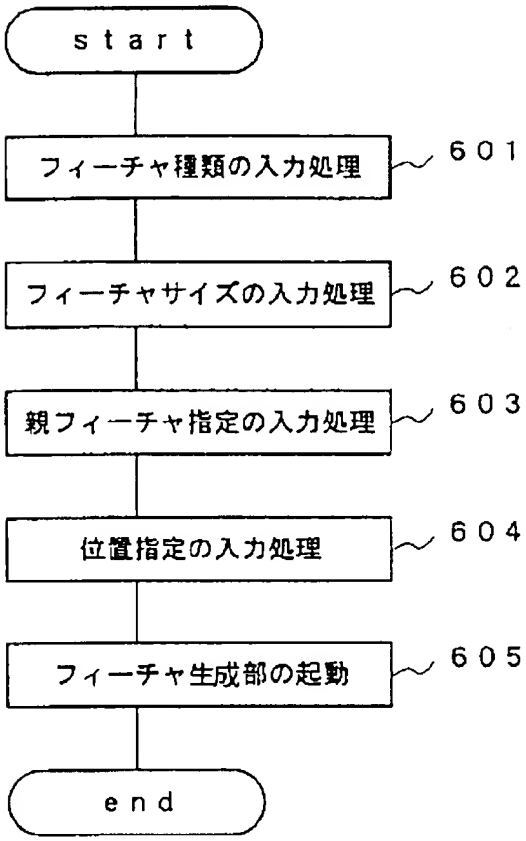

[Drawing 5]

図5


フィーチャ生成操作
部品形状
長方形基準板
フィーチャ1
フィーチャ2
コーナーR
フィーチャ3
バーリング
長方形切欠き
フィーチャ4
長方形付加板
フィーチャ5
ボルト用切欠き
フィーチャ6
タッピンネジ用
バーリング穴
フィーチャ7

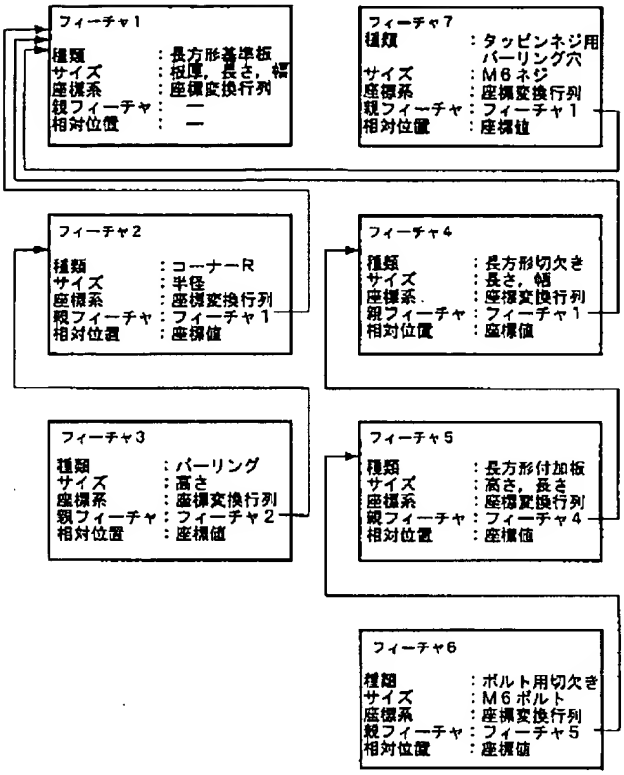
[Drawing 6]

図6


start
フィーチャ種類の入力処理
601
フィーチャサイズの入力処理
602
親フィーチャ指定の入力処理
603
位置指定の入力処理
604
フィーチャ生成部の起動
605
end

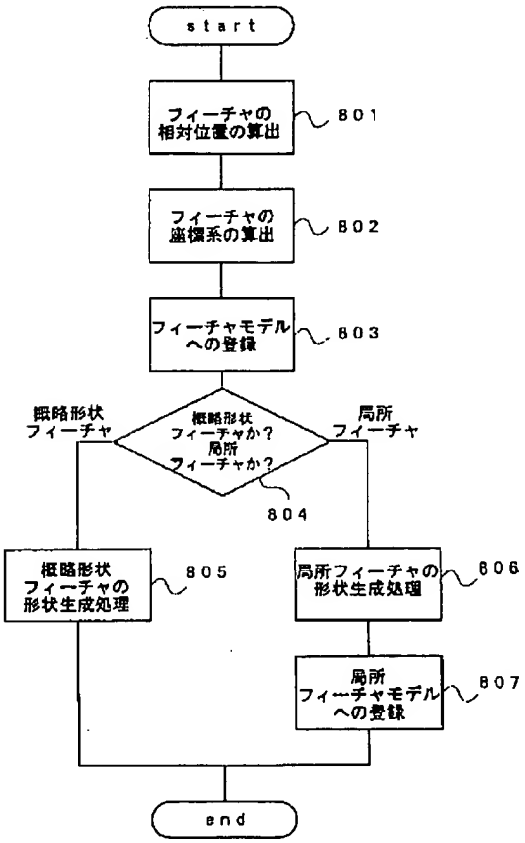
[Drawing 7]

図7



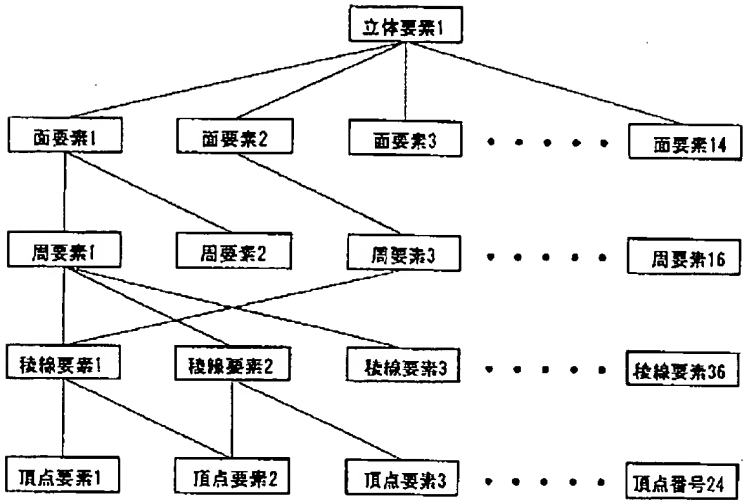

[Drawing 8]

図8



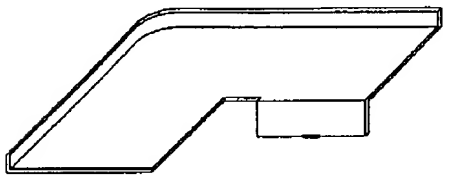
[Drawing 10]

図10

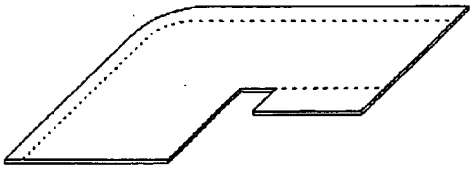



[Drawing 11]

図11



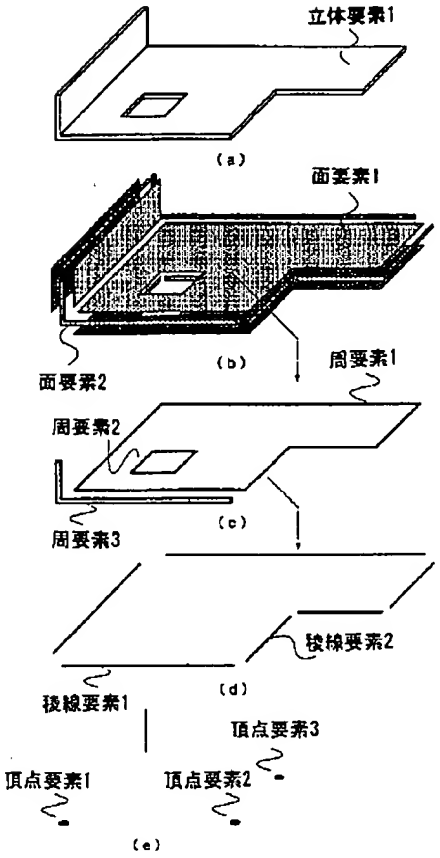
(a)



(b)

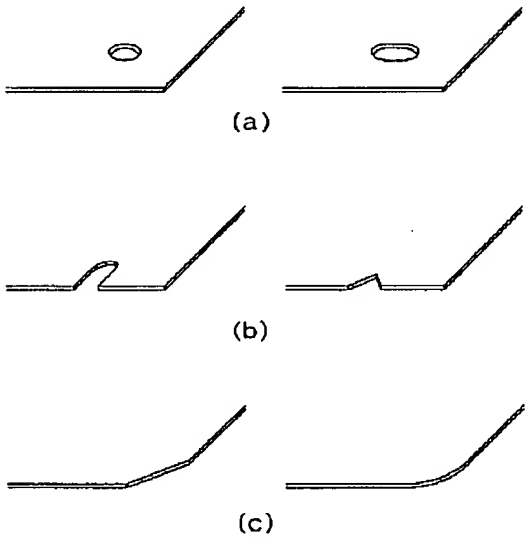
[Drawing 9]

図9



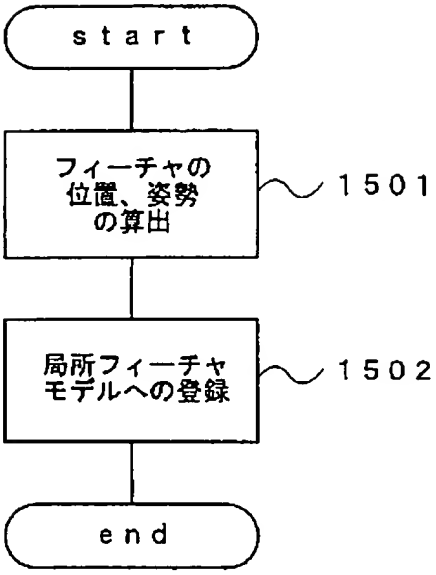

[Drawing 13]

図13



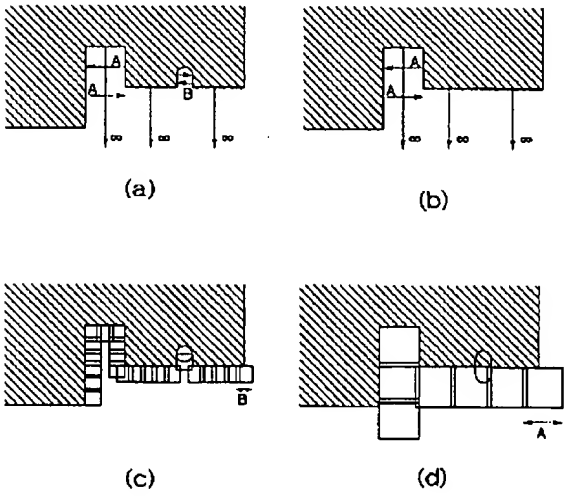

[Drawing 15]

図15



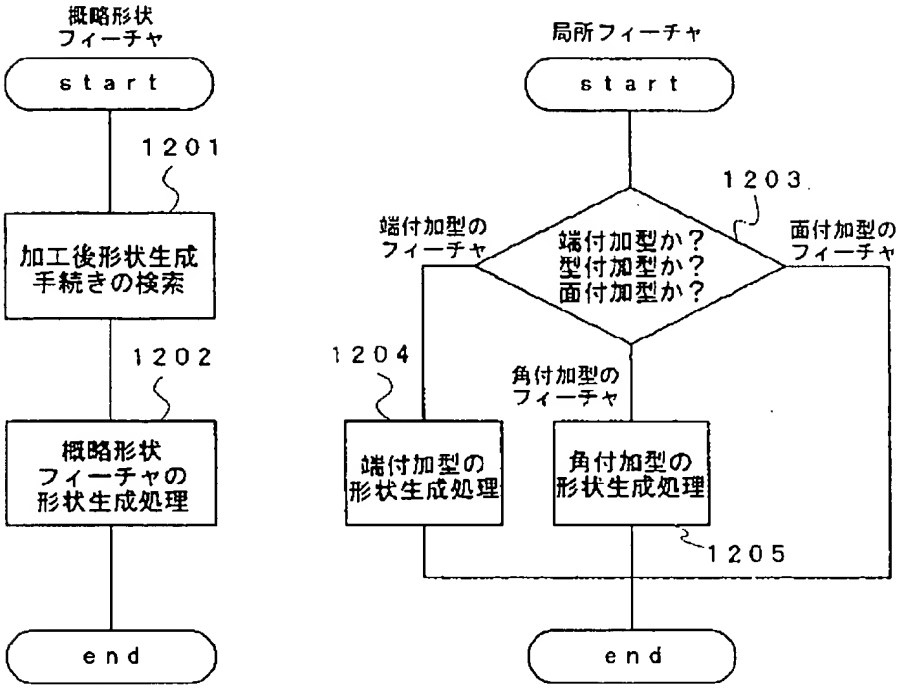

[Drawing 18]

図18




[Drawing 12]

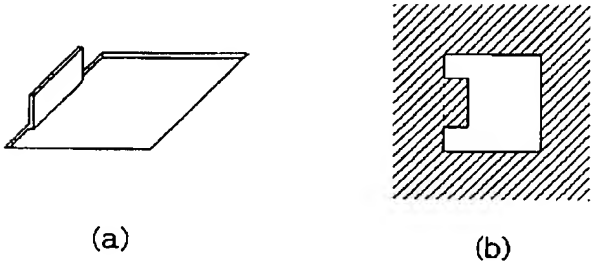
図12




(a) (b)

[Drawing 19]

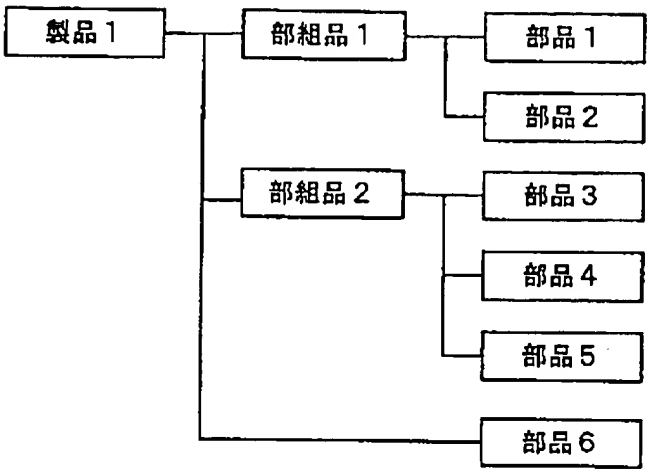
図19



(a) (b)

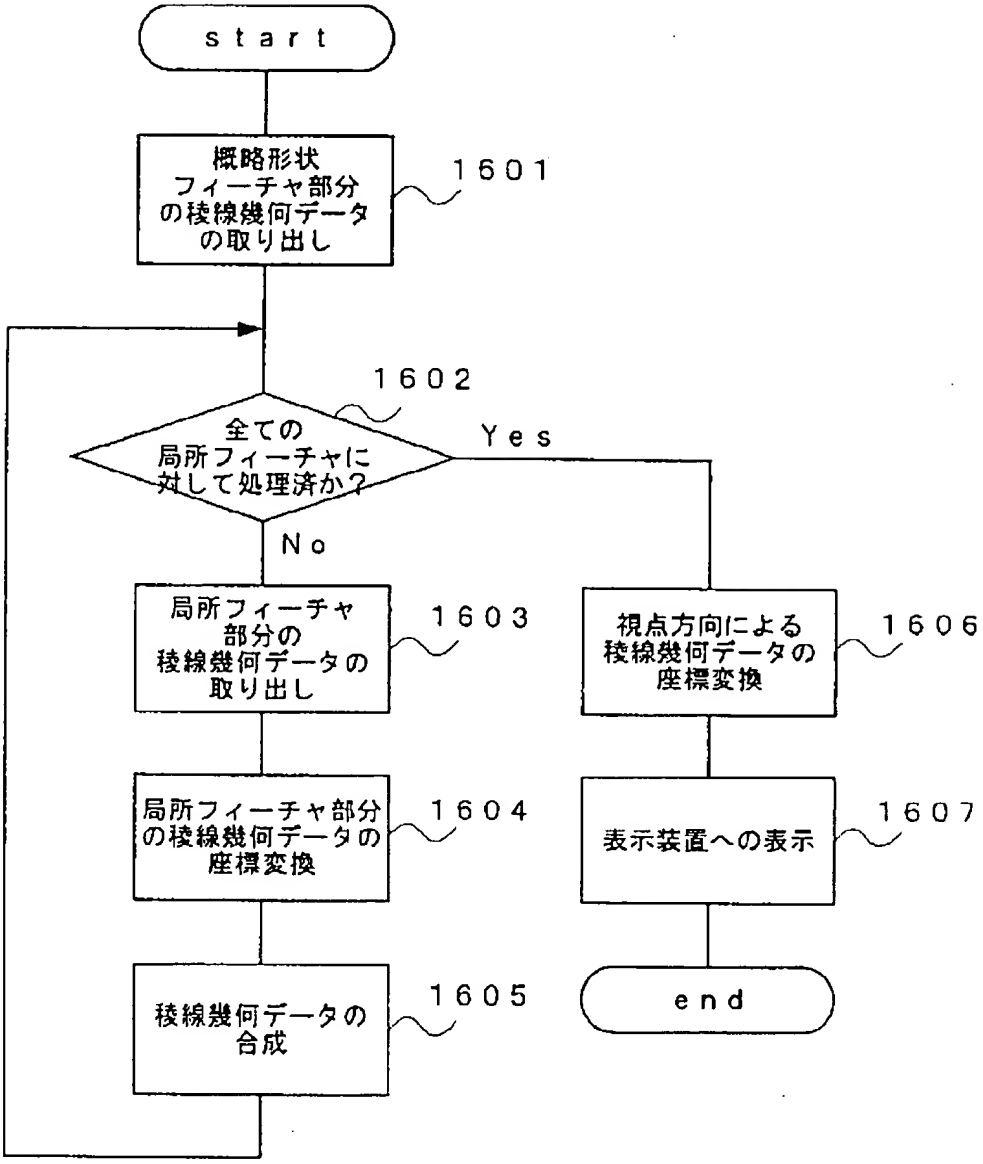
[Drawing 24]

図24



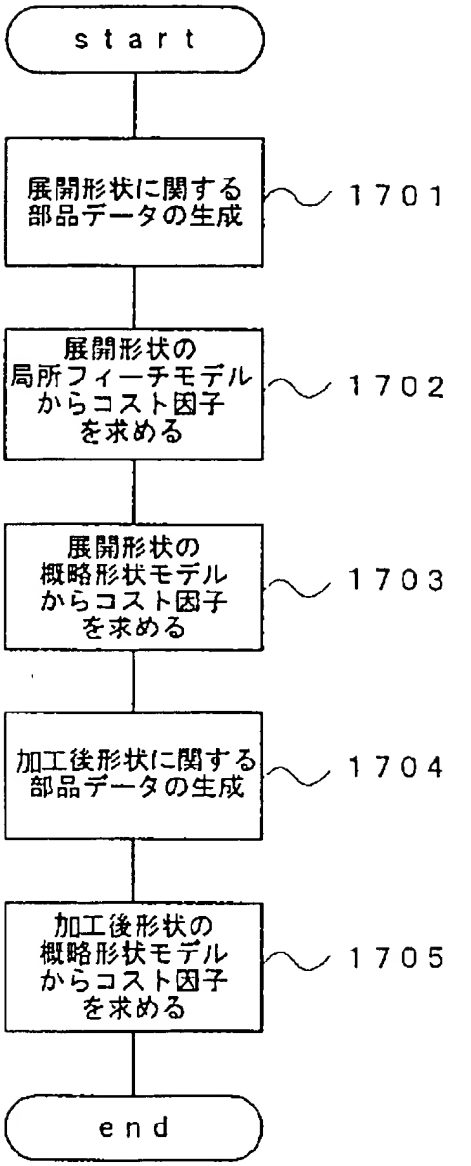

[Drawing 16]

図16



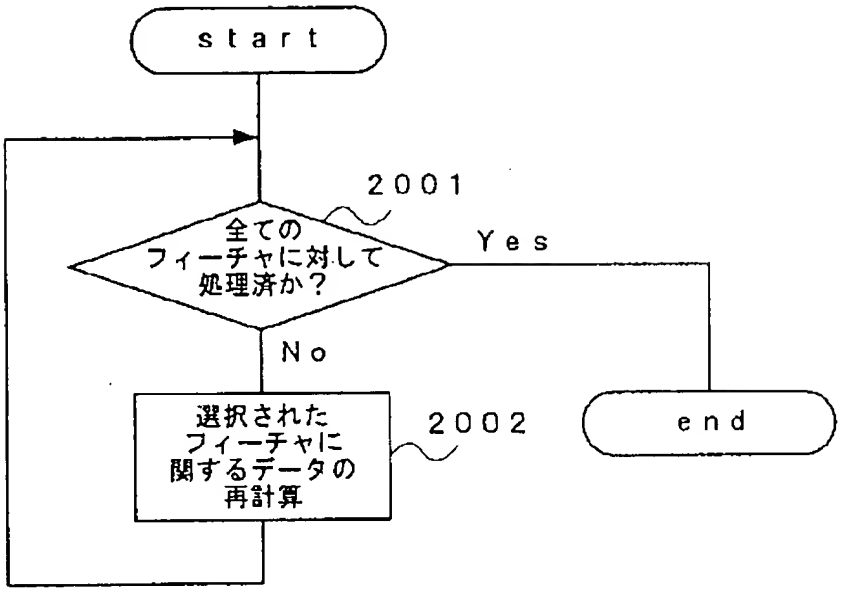

[Drawing 17]

図17



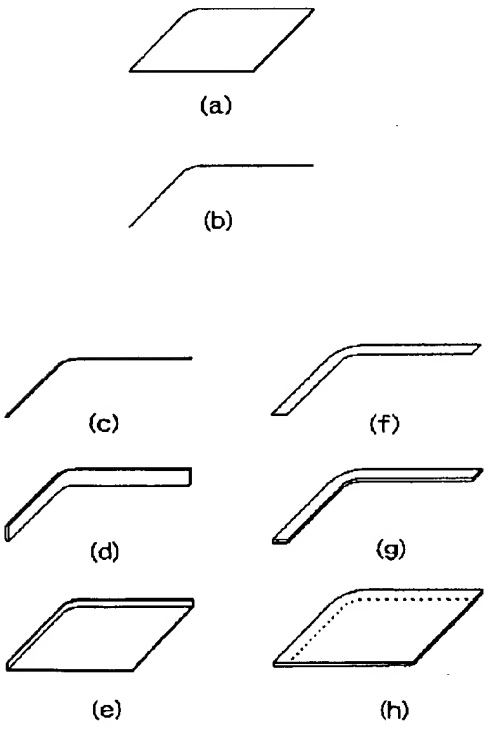

[Drawing 20]

図20



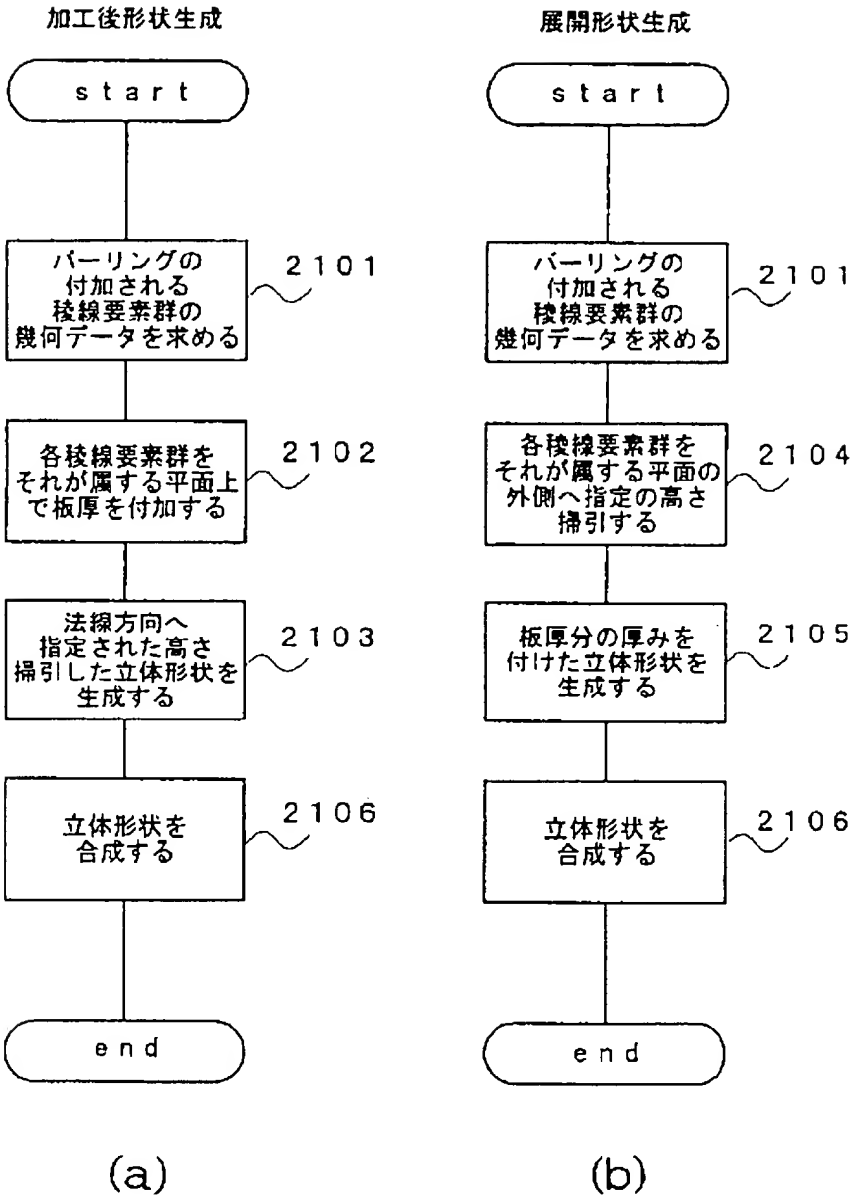

[Drawing 22]

図22




[Drawing 21]

図21




[Drawing 23]

図23

(a)

素材基準コストデータ

| 板厚(mm) | 単位面積当たりのコスト(¥/m$^2$) |
|---|---|
| 0.8 | 100.0 |
| 1.0 | 120.0 |
| 1.2 | 130.0 |

(b)

展開加工基準コストデータ

| パンチ金型の種類数（種類） | パンチ回数当たりのコスト（¥/回） |
|---|---|
| n≦20 | 2.0 |
| 20＜n≦30 | 4.0 |
| 30＜n≦40 | 7.0 |
| 40＜n | 10.0 |

(c)

曲げ加工基準コストデータ

| 曲げ線の長さ(mm) | 曲げ角度(°) | 曲げ当たりのコスト（¥/回） |
|---|---|---|
| L≦60 | θ≦90.0 | 25.0 |
| | 90.0＜θ | 60.0 |
| 60＜L | θ≦90.0 | 35.0 |
| | 90.0＜θ | 80.0 |

[Translation done.]